Task Order #1B

Arena/Horse Barn Structural Evaluation

Department of the Interior
Bureau of Land Management
Eastern States
Meadowood SRMA
Lower Potomac Field Station

April 26, 2011

By
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EXECUTIVE SUMMARY

The preparation of this inspection and analysis report was contracted by the Bureau of Land Management (BLM), Lower Potomac Field Station as part of the Meadowood Equestrian Facilities Planning Process. This report shall render an opinion as to the structural condition, deficiencies, repairs and costs needed to extend the life of the horse barn at the Meadowood Special Recreation Management Area in Lorton, Virginia., and bring the facility up to the International Building Code of 2006 (IBC) which is current standard used by the BLM.

The barn was constructed in 1976 and has an overall square footage of 26,000 square feet. It's constructed as a traditional post-frame building (pole barn) whose primary framing system is comprised of wood roof trusses and rafters connected to vertical timber columns. Pole barn structures are popular due to the low up front cost of construction. The facility was inspected by a team of engineers during the week of February 7, 2011. The facility was scanned and surveyed for plumb and level. Structural members were visually inspected to determine size, signs of decay, and deterioration. An overall inspection was performed to determine the quality of workmanship. Wood and soil moisture readings were also taken at various points in the structure. An earth auger was used to expose buried portions of 33 of the 176 columns. Moisture readings were taken at various intervals of the columns. Wood samples were taken and sent to a laboratory to determine species.

While the structure is not in immediate danger of collapse, the type, age and condition of the structure suggest that this facility is at the end of its useful design life. Major remediation would be required to repair this facility so that it can continue to be safely used, even under minimum IBC standards for a Class U (Utility & Miscellaneous Group) structure.

To preserve the structure and bring it up to the minimum standards for an IBC Class U structure, POZ estimates the structural repair costs alone to be $554K. To preserve and upgrade the building to Class A or B, the cost is estimated by POZ to be $1.05M. The following outlines what would be required for this structure to meet IBC 2006 standards.

1. Shallow foundation system – The investigation of the column support system delineated that the shallow foundation system consisted of undisturbed or compacted soil with some evidence of a concrete base at one location. For new construction a column base must be placed under each column in order to make the structure code compliant. The field investigation was inconclusive in regards to the existence of column footings. It is therefore recommended that four additional columns be excavated at various locations for full exposure to the base to determine the presence and size of any base material. In addition, horizontal borings should be made into the wood column to determine if any decay is present.
2. If it is determined that foundations are not present under the columns, foundations should be placed under each column.
3. Columns – The extended use of this building at the current IBC classification would require the exposure of the below surface portion of the columns to identify decay by exposing the center face of the column and augering test holes in the wood to determine if decay exists on the interior of the column. If decay is present, the report gives measures for replacement. If the structure is to be upgraded to meet the IBC, then all deteriorated column members would have to be either removed or cut to allow for a code compliant foundation system.
4. Purlins –All purlins should be replaced or reinforced. Trusses and Beams –The trusses by themselves are adequate for Class A, B, & U loads, but do not have adequate top & bottom chord and cross bracing to meet the IBC standards.
5. Bathroom Facilities – Bathrooms are not required by the IBC for a Class U building, however the BLM is required to provide accessible restroom facilities whenever remodeling existing non-ADA

compliant restrooms In order to upgrade to a Class A or B building use, installation of restrooms would require the loss of 2 or 4 horse stalls. In addition, the ADA would require other amenities for easy access to restroom facilities: concrete walkways, better lighting, hand rails, etc.

6. The following are electrical recommendations: installing GFCI receptacles for personal protection, grounding electrode system should be verified, install knock-out covers in panel box, update the panel box directory , install lighting fixture covers, and replace the existing wiring with code approved wiring [3].

7. A fire sprinkler system is required for meeting IBC U, A, or B Classification due to the type of construction and square footage of the structure.

While there were some obvious shortcomings from the construction of this structure, it has performed well for its intended use and has reached the end of its design life (25 to 30 years). Most existing shortcomings are due to water infiltration through the roof and walls. Any attempt to remediate the structural components for its present use without addressing the weather tightness of the building skin would be wasteful and result in a repeat of the current shortcomings. Upgrading the facility to change its intended designed use from a Utility & Maintenance structure to meet IBC standards for an Assembly or Business structure would be difficult and complex. Structurally, the complexity begins at the foundation level and permeates to the trusses and the roof itself. Since this is a public facility and public visitation exists through special riding programs, building upgrades would fulfill a public need.. For instance, the present restroom facility is not ADA compliant and access to the present restroom would be challenging for wheelchair access. Furthermore, by industry standards the existing arena size (60 ft x 190 ft) only accommodates training and practice [7]. Presently there are limited non-accessible accommodations for spectators, which fit the present classification and building use.

To upgrade the facility for competition and exhibition in accordance to the United States Equestrian Federation (USEF) would require increasing the width of the current arena. There are two sizes for Dressage Competition arenas: small and standard. The small arena is 20 m by 40 m (66x131 ft) and the standard arena is 20 m by 60 m (66x197 ft) [7]. The current arena does not meet the width requirement for either. The existing arena cannot be enlarged to accommodate the increased width requirement due to the truss span and support columns of the existing trusses (60ft).

It should be noted that any extensive work performed on the facility will probably require the temporary relocation of horses due to the noise and commotion anticipated.

A. INTRODUCTION: POZ Environmental, LLC (POZ) was tasked by the US, Department of Interior, Bureau of Land Management under Contract No. L10PA00209 to assess the structural integrity (Phase 2) of the existing 26,000 square foot horse barn at the Meadowood Special Recreation Management Area (SRMA) located in Lorton, Virginia, about 18 miles south of Washington DC (Figure #1 - Location Map). This report includes: the investigation of the wood support columns to determine if decay has taken place; gauging the trusses to determine if any movement has occurred; inspection of the purlins for the condition of the roof in the arena area; analysis with recommendations to extend the useful life of the building 25 years; and upgrading from a Class U with construction cost to meet the International Building Code (2006) for Class A and B occupancy classification. POZ Environmental, LLC (POZ) is an engineering firm located in northeastern Pennsylvania, practicing principles of engineering for solutions to environmental, civil, structural, and geotechnical challenges. The principal investigators/engineers for this task were: Emanuel T. Posluszny, P.E. (Project Manager), Jeffrey Kelly, P.E. (Structural Engineer), Marc Bowen, P.E. (Architectural/Structural Engineer), Nathaniel Ling, P.E. (Field Engineer), and Guy DeAngelo, EIT, PLS (Surveyor). This team (see Section I) has designed, managed, and inspected both steel and wood frame structures.

B. BACKGROUND:

1. The barn is owned and managed by the Department of the Interior, Bureau of Land Management, Eastern States, who acquired 800 acres of the Meadowood SRMA in 2001 with the primary purpose of managing the open space for recreation, environmental education, and wild horse and burro interpretation. The barn is one of many structures that make up the original riding complex/farm, which was initially a private facility. The barn is 104 feet wide by 248 feet long, and constructed in 1976. It consists of a light gage metal (aluminum) siding applied to wood framing with horse stalls located along the perimeter of the two long sides with adjacent aisles for access which are each about 13 feet wide. The complex has stalls for about 48 horses, with an office area, toilet room, mechanical room for pumps, two horse washing bays and an overhead misting system for dust suppression. The arena, located in the center of the building, has double trusses at eight foot centers with a span of 59 feet 7 inches (approximately 60 feet). The arena is approximately 190 feet long, with a platform area at one end. Behind the platform is a set-up area which takes up the remainder of the barn at approximately 40 feet in length. [1]
2. The facility is a traditional pole barn consisting of a center truss area flanked by two single span, sloped rafters. The center truss creates the 60' wide arena area, which classifies it as a practice and training arena for dressage [7]. The first sloped rafter spans the aisle, the second spans the horse stalls. The trusses are double fink style. There are two trusses, side by side, every 8'-0". The trusses are supported every 8'-0" by 6x6 wood post (columns). The posts are buried approximately 42 inches below the surface. The columns appear to have a field applied preservative treatment below grade. Collector purlins are used to transfer the roof load into the trusses at the arena and into the wood ceiling rafters at the aisle and stalls. The purlins are 2x4" dimensional lumber spaced at 24" on center (o.c.) at the arena and 2x4" dimensional lumber, flat axis, at the single span rafters. The rafters are 2x12 dimensional lumber spaced at 4'-0" o.c. The rafters are supported by wood beams spanning the length of the building. These wood beams are single 2"x12" dimensional lumber faced nailed to the east and west side of each column. On the arena aisle side, they have a span of 8'-0". On the horse stall side, they span 10'-0". The existing building dimensions are: 104.5' wide, 246' long, sidewalls are 9' high, ridge height is 26', floor area is 25,707sf, roof area is 27,060sf, and the wall area is 8,900sf.
3. In April, 2008, BLM assessed the conditions, needs, and integrity of the Arena/Stable facilities. After some initial inspections, BLM observed several shortcomings of the complex. One of these short

comings was life safety and stock safety based on potential fire. After initial site visits by architects and engineers from the BLM National Operations Center (NOC), and several delays due to construction difficulties, a waterline was installed with a fire hydrant for the application of fire suppression system(s) at the site. In addition, BLM noted that the structural integrity of the Barn/Stable was called into question as to the ability to carry the additional loading of a fire suppression system as well as the current condition of the electrical distribution for both power and lighting. The approach of this investigation was to first examine the condition of the facility to determine what corrections needed to be made. The next step was to assess the feasibility of utilizing the existing structure, which has several shortcomings, such as an arena which does not meet current recommended United States Equestrian Federation criteria. Due to the apparent extent of retrofit necessary, BLM gave consideration to four alternatives with one alternative for building a new facility, which would meet recommended size requirements for arena and stalls. [1]

4. In December 2010, a rapid assessment was made by POZ Environmental, LLC in a Phase 1 type activity for the structural and electrical components of the barn [2]. In this assessment, POZ noted:
    a. The safety inspection of the barn was considered to be straight forward with a general conclusion that structural design was not a major consideration with the construction of the horse barn. Although the structure has withstood the test of time (34 years), it was built with “short-cuts” and minimal consideration for factors of safety, as noted by this assessment. POZ believed that as time progresses, the maintenance of the barn is expected to be costly and excessive.
    b. A weak point in the truss system (northeast corner) needed to be replaced (completed by BLM in January 2011).
    c. Concern that the roof could fail in a substantial wind or snow storm event.
    d. The current overhead location of the dust suppression system, which needs to be evaluated due to proximity to electrical systems below.
    e. Ground fault circuit breakers should be installed for the lighting and receptacles in the stall aisles and arena area of the barn.
    f. Further investigation of the columns to determine how much decomposition has taken place beneath the surface in order to determine the feasibility of preserving the existing structure.
    g. It was also recommended that compression at the intersecting point of the beam and the trusses and the movement of trusses be further investigated.
5. Later in December of 2010, Fairfax County (County) staff from Department of Public Works and Environmental Services (DPWES) was requested by Fairfax County Supervisor Gerry Hyland, Mount Vernon District, Fairfax County to assist in the review of proposed plans for the modifications and/or replacement of the horse barn/arena facility in the Meadowood Special Recreation Area in Lorton, Virginia. DPWES staff invited staff from Fairfax County Park Authority to assist with the evaluation from an equestrian facility programming perspective. The purpose of the request was to provide a independent inspection of the structure from a separate government agency. They also reviewed the findings of the Horse Barn Assessment Report dated December 3, 2010 by POZ Environmental, LLC (POZ) and the Arena/Stable Rehabilitation study report dated April 2008 by Division of Architecture and Engineering Services, National Operations Center for the Bureau of Land Management. In addition, issues specific to Fairfax County or Virginia regulations as well as a number of programming items relative to this facility type were also included in the County’s December 2010 report. The report represented a basic assessment that was based on observations by County staff during the site visits on December 8 and 13, 2010 and the two study reports by POZ and BLM. The County’s report addressed site/civil, architectural and building program, structural, electrical and plumbing issues and provided applicable recommendations. An evaluation of the preliminary cost comparison contained in the 2008 BLM Report was also included. Since one of the

goals for the facility identified by BLM was to provide better public access for equestrian events, as well as public riding classes, the County made recommendations which were included in its report to address deficiencies related to the programming needs for better public access and use of the facility. The County report noted the existing conditions and recommendations in each section of their report and concluded that in order to determine the facility's functionality to provide the desired programs and better public accessibility, the integrity of the existing building systems as well as the cost effectiveness and lifecycle usability was required. This included analyzing the cost of renovating the existing building or replacing with a new facility. The County report stated that a rigorous investigation and a complete analysis of all elements of the buildings including structural, electrical, and plumbing components as well as the site conditions must be conducted. The County further concluded in the structural assessment portion of their report that the investigation of the structural members must be conducted as soon as possible to obtain a better understanding of the current deficiencies and the building's structural integrity in order to address safety concerns. [3]

C. EQUIPMENT AND INSTRUMENTATION – The objectives of the investigation were to:

a. Determine structural integrity and recommend measures to extend the useful life of the building 25 more years;
b. Upgrade the building structural members and life safety requirements to meet the International Building Code (2006) for Class A and B occupancy classifications [4];
c. Estimate associated construction cost for repair/life extension for both a Class A and B classification.

This study consisted of an analysis to: investigate the wood support columns to determine if decomposition has taken place; gauge the trusses to determine if any movement has occurred; and inspect purlins for the condition of the roof in the arena area. The following equipment/software/instrumentation was used in this analysis:

1) Mechanical diesel-Powered Soil Auger
2) Shovel
3) Digital Camera (8 mega pixel)
4) Folding rule
5) One-inch hole saw with cordless drill
6) Plastic wood
7) Barn layout map, AutoCAD drawing supplied by BLM
8) Soil moisture meter with a 24-inch probe.
9) Wood Moisture meter with 11/16-inch probe
10) Two-man lift.
11) ROBOTIC SURVEYOR TOPCON
12) CARLSON SURVEY, VERSION 2010
13) Topcon 3-D Scanner
14) AutoCAD 3-D Civil, 2011

D. OBSERVATIONS AND FINDING OF FACTS: The purpose of this study was to identify structural elements in the building including load bearing walls/elements, post and beam structures, tension members, soil analysis, soil and wood moisture, and species of wood. A general field coordinate system was established by writing a truss number, which BLM had established in their drawing submittal for this study, on the column beginning at the southern end of the barn.

1. Columns – The study consisted of inspecting the columns below ground surface to:

a) Inventory each column and annotate in the field book as ExA (Column (C) - east (E) – sequential number (x) from the south to north– arena area (A)) or WxA. Columns in the front (north) and back (south) of the barn are labeled 33Dx (north – sequential number from the west (x)). For the purpose of this report, the coordinate system follows Figure #1 (see Appendix A), such as: 1A (southwestern corner of the barn), 33G (northeastern corner of barn), etc.

b) The soil moisture was measured at every column. The soil moisture meter was calibrated to the indigenous soil at 1E. A soil sample was also taken at the same location and sent to a laboratory for analysis of gradation and moisture content (see Appendix C). The results of this analysis are presented in Appendix B, Tables # 1a through 1d, which shows the variation in the soil moisture at 6-inch intervals. In most cases the soil was so hard and dry it was difficult to penetrate to a 24-inch depth with the probe, without drilling pilot holes. Because pilot holes alter soil moisture readings the probe was pushed into the soil to the point of refusal, and readings at 6 inch intervals to that depth were taken.

c) The soil moisture data was used to locate and investigate subsurface conditions of the support columns for the barn: 12 columns in the arena area on line C and E (6 each) on the coordinate system, 4- 12 inch diameter auger holes along line B, 4 auger holes on line F, 4 auger holes on line G, 4 auger holes on line A, 2 on line 33, and two on line 1. A total of 32 columns were augered to a depth of approximately 30 inches along one face of the column for inspection. One column (C5) was augered and hand shoveled to a depth of 42", which appeared to be the bottom of the column. No concrete footing was found, but some stone/aggregate material was present in the hole at that depth, which may have been part of a footing. The soil profile and wood column was photographed (see Appendix A as Figure #4) using a folding rule as a legend and a wood moisture meter for moisture content at 6-inch intervals to a depth of 24 inches. This data was annotated in the field book and is also listed in Appendix B as Tables #1a to 1d of this report. After the data was successfully collected, the auger holes were backfilled with VDOT 21A aggregate and compacted in 6-inch lifts.

2. **Trusses** – This inspection was to provide information of past movement of the trusses.

a) An inventory of 33 trusses was made with respect to the BLM drawing and annotated in the field book as a sequential number from the south (1). A two-man lift was used to visually observe (see Appendix A, Figure 5) and annotate any inconsistencies or problems in the truss system. This observation was accomplished in conjunction with the purlin observations; see below.

b) A rapid static survey of control points in arena area was conducted to tie into boundary for control with the robotic surveyor and traverse to truss points at: Apex of truss, Upper-Lower Chord intersections, Beam-Lower Chord intersections, and all web intersections with Upper and Lower Chords. The survey equipment was used for control network to place the structure in a spatial coordinate system. Points were checked with OPUS and RTK, angle of convergence checks to a tolerance of 0.25 inches. Baseline – Values were based off of the most southerly truss to the ground surface. Measurements to the nearest 1/4" and annotated as +/- were recorded. Data was downloaded into AutoCAD 3-D Civil 2011 and mapped in 3-D image. The BLM CAD drawing of the entire barn was imported into the surveyed drawing to add the stalls and other facilities of the barn, and converted to a 3-D image; see Appendix A, Figure #2.

c) A 3-D scanner was also used in this analysis. The scanner was set-up in four positions using the rapid static survey controls. The scanned data and image was downloaded into AutoCAD 3-D Civil software and is shown in Appendix A, Figure #3. The scanned image in Figure #3 does not show the horse stalls because the instrument was not setup in stall areas. Therefore, the arena perimeter fencing and the inside walls of the stalls blocked the scanner from recording the inner dimensions of the stalls and consequently the full dimensions of the structure. However, this technology was only used to investigate the alignment of the truss system.

3. **Purlins** - The condition of the purlins and roof was also inspected and listed in Appendix B, Table #2. The data collected was through visual observation and wood moisture content, which was

annotated in the field book and includes: Decay or water staining, missing fasteners, unsecured sections, and moisture content.

4. **Wood Species -** Core samples were taken from three typical structural members: beam (2x12 at 27C), truss (2x10 - lower chord member at 28D), and column (6x6 at 14E). The holes were filled with a plastic wood. The samples were collected in a white envelope and marked to identify the typical structural member. The envelopes were sent via Express Mail to Penn State University College of Forestry. The analysis of the wood revealed that the general species is a hard yellow pine. The letter for the analysis is in Appendix C.
5. **Electrical and Mechanical Components** – The electrical component of the structure consists of wiring, lighting, distribution box, and the dust suppression system [2]. The electrical service originates from the 400 amp service at the old house on the east side of the Storage Shed. The house has a 400 amp service which consists of a 200 amp panel that provides power for the house and a 200 amp disconnect which provides power to the Storage Shed, the Workshop, the Storage Building, the Ferrier Building and the Barn/Arena [3].
    a. **Wiring** – The wiring consists of 10-2 BX and 12-2 BX wire, and is visible and stapled to the beams and posts of the barn and runs to supply power to the stalls, lighting fixtures, dust suppression systems, and power connections in general. The wiring is metal shielded to protect the wire from rodents and horses from chewing through the protective coating [2]. The National Electrical Code (NEC) requires the lighting fixtures equipment enclosures, boxes, conduit bodies and fittings to be protected from physical damage and installed to minimize the entrance of dust, foreign matter, moisture and corrosive particles [3]. The wire jacket is exposed to the mist of the dust suppression system and was generally showed surface rust. Rust is prevalent at the overhead light fixtures in the aisle between the arena and stalls [2].
    b. **Outlet Boxes-** The County had assessed that the outlet boxes are not the approved type to keep out dust nor are they designed for wet or damp locations. Many outlet boxes show signs of rust and/or corrosion [2,3]. The outlet boxes that are installed next to the stalls are not protected from physical damage. An extension ring has been welded to the face plate in an attempt to provide some level of protection from physical damage to the devices but does not provide sufficient protection [3].
    c. **Lighting** – The lighting consists of elongated florescent tubes throughout the barn. The light fixtures are situated near and at a lower or equal elevation than the dust suppression system. Switches of the lighting are located on the walls with horse protective shields [2]. The light fixtures appear to be high enough to be protected from physical damage but are not approved to keep out dust nor are designed for wet or damp locations. The County has assessed that there are approximately forty-one open tube fluorescent light fixtures. None of these fixtures have protective lamp covers that would keep broken glass and mercury filament, in case of a lamp burst, from falling on people, animals or the ground. A good number of light fixtures show signs of rust and/or corrosion. Several light fixtures were not illuminated at the time of the County or POZ assessment [3].
    d. **Distribution Box** – The panel box is labeled ITT Imperial Corporation. The total amperage coming into the box is 200 amps. There are 28 positions and 26 breakers [2]. The box lacked distinct and clear labeling for the breaker assignment [2,3]. There were no loose wires that were not capped, and no wires jumping or cross breakers, but the panel box had missing knockouts exposing the inner components of the box [2,3].
    e. **Dust Suppression System** – The dust suppression system consists of two Franklin Electric pumps, piping running the length of the barn with sprayer nozzles on the top of the pipe spaced continuously throughout the run. The runs were also spaced as follows: 4 lines run

longitudinally through the arena area and 2 lines ran longitudinally through the aisles between the stalls and the arena. These lines should have been positioned lower in elevation, especially with respect to the electrical system. A dust suppression system is a necessary safety measure because electrical arching or an open flame in a dusty area can cause dust explosions. However, location of the system relative to electrical wiring is also important [2].

f. **Fire Suppression System** – The building has no fire protection in place other than a fire hydrant at the eastern outside portion of the structure. No observation of smoke or fire alarms were made or annotated.

E ANALYSIS - The overall condition assessment will describe the current state of the existing, in-place structure as compared to the as-built condition (see Appendix C). The in-place condition of the structural members of the facility is poor. This facility is 34 years old and should be near the end of its design life.

1. **Shallow Foundation System –** The existing footing is assumed to be undisturbed soil from observations at C5 at a depth of 42 inches with some evidence of a concrete base at one location Code required footing for 7250 pounds (DL + LL) on each column (see Appendix C) with an allowable soil bearing pressure of 2000psf results in a concrete footing of 2 foot diameter and a minimum thickness of 6 inches, which does not appear to be present under the columns [4]. As per the *American Wood Council – Design for Code* Acceptance, for a post-frame building to be compliant with the International Building Code, the foundation system must be evaluated with respect to the load bearing value of the soil (IBC section 1804) and have a foundation of pre-cast or un-reinforced concrete. The diameter of this concrete pad is to be determined by the vertical load in the post. The analysis shows a minimum diameter of 2'-0" is needed for the columns supporting the trusses, a minimum diameter of 1'-6" is need for the stall side aisle columns, and a minimum diameter of 10" is needed for the perimeter columns. However, since only one column location was excavated deep enough to expose the column base and some type of base material appeared to be underneath, this issue remains undetermined. It is therefore recommended that four additional columns be excavated at various locations for full exposure to the base to determine the presence and size of any base material. In addition, horizontal borings should be made into the wood column to determine if any decay is present
2. **Columns -** The above grade structural condition of the columns is good. Unfortunately, for a structure of this type, the problems arise in the below grade state. An orderly sampling of columns were investigated using an earth auger to expose one face of the below grade portion. All columns had 30% moisture content in the wood at the below grade areas, which is excessive. According to the Southern Pine Association, marginal decay exist for moisture content ranging from 20-25%, Optimum decay exist for moisture content greater than 25%. The results of the moisture content are listed in Appendix A. The extent of the rot was not always visible, except in the eastern part of line G. Wood decays from the inside and permeates outward. The exterior may show no sign of decay but the sectional loss within can be considerable. The above grade moisture readings had typical moisture contents between 12-15%. However, there were a few isolated signs of above grade decay. Code requirements for a Type V building using column supports approves the use of pressure treated timber in accordance with American Wood Products Association (AWPA)U1 and Section 2303.1.8 of IBC 2006. However, no observations of pressure treated wood treatment were made nor annotated per Section 2303.1.8.1 of **IBC standards**. Typical construction techniques used at that time were to place the bottom portion (the anticipated length enclosed by soil) of the post in a vat of treatment material such as creosote and let stand for 24 hours.

3. **Trusses -** The overall structural condition of the trusses is good. The survey equipment used in the data collection did not show any uniform lateral movement. The trusses appear to be designed for the standard agricultural load of 25-5-2. This means they are designed for a snow load of 25 pounds per square foot (psf), a roof dead load of 5 psf and a bottom chord dead load of 2 psf. These loads agree with the in place observation and local snow load criteria [4]. This analysis shows the trusses are adequate to withstand these loads based upon the visual observations and instrumentation used. However, modifications would need to be made to bring the structure up to the standards for IBC Class U, A, or B, because the original installer appears to have taken shortcuts in the installation. Based on this analysis, the top and bottom chord must be braced continuously at 1/3 points, which was not done consistently in the as-built structure. The truss system requires cross bracing along bottom of roof purlins, sway bracing, bottom chord diagonal bracing, bottom chord continuous bracing, web plane diagonal bracing and gable end bracing.
4. **Purlins -** The overall condition of the purlins in the truss area is average to poor with the upper most purlins ranked as the poorest. These purlins appear to have water damage and early signs of rot. Most rot is taking place at the connection point where the metal panel is connected to the purlins. This suggests the metal panel roof is leaking probably through the roof fasteners impacting the purlins at the panel-purlin connection. The overall condition of the purlins in the stall and aisle area is also poor with over half showing signs of rot. Moisture readings in Appendix A showed members to have content in excess of 20%. The 2x4 purlins that are present in the existing structure meets a Type V structure and consequently does not conform to a Type IV due to purlin size, which is nominally 4x6 lumber [4]. Therefore, this structure does not meet IBC 2006 requirements for upgrade.
5. **Rafters -** The overall condition of the rafters is adequate for this structure. Should repairs be made to the structure, a few isolated rafters would require repair or replacement. Most areas of decay are located near the exterior walls of the stalls.
6. **Lateral System -** There is no apparent lateral load resistant system present in the structure. It appears that the original intent was to use the buried portion of the columns to act as a "flag pole" in conjunction with knee bracing at the column-beam connection in order to resist the lateral loads. Furthermore, it is believed that the 2x6 horizontal railing that lines the aisles and separates the horse stalls has unintentionally acted as a shear wall, reducing the effective length of the column for lateral loads. While the outcome of this has been positive, there is little way to quantify it from an analysis perspective.
7. **Bathroom Facilities -** The present restroom is approximately 20sf and consists of: a water closet, and a lavatory with hot and cold running water. In order to upgrade to a Class A-4 building, the following must be met: 1 water closet (WC) per 75 males, 1 WC per 40 females, 1 lavatory (LAV) per 200 males, 1 LAV per 150 females, 1 drinking fountain (DF) per 1000, and 1 service sink. To upgrade to a Class B: 1 water closet (WC) per 25 males, 1 WC per 25 females, 1 lavatory (LAV) per 40 males, 1 LAV per 40 females, 1 drinking fountain (DF) per 100, and 1 service sink. The Americans with Disabilities Act (ADA) and federal rules require any newly constructed or remodeled facilities must meet Accessibility codes.

F. **CONCLUSIONS AND RECOMMENDATIONS -** While the structure is not in immediate danger of collapse, the type and condition suggest that this facility is at the end of its useful design life, and major remediation is required to maintain it into the future. This study focuses on the costs to renovate the structure to meet IBC Class U, A or B requirements. Should the Bureau of Land Management choose to keep the facility and/or change its usage, the order of need, for repairs is as follows:

1. Shallow foundation system – The investigation of the column support system delineated that the shallow foundation system consisted of undisturbed or compacted soil at a nominal depth of 42. However, a column base of 2 feet in diameter and a minimum of 6 inches thick must be placed under each arena column in order to be code compliant. This diameter is based on a 6800 pound concentrated load at each arena column support. The depth of the foundation system will depend on the frost line in the soil, which is 24 inches [11]. The action of making this structure code compliant will require special consideration and may evolve the removal and replacement of the entire structural system, i.e. the barn in its entirety.
2. Columns – The extended use of this building at the current IBC classification would require the exposure of the below surface portion of the columns to a depth of 24 inches to identify any decay or deterioration. Once exposed, the center of one face of the column should be drilled at 6" increments to determine if the interior of the column is competent. If decay is present the structure should be shored at this location, the full column removed or cut at projected concrete surface, and replaced in-kind with a new column or concrete. In addition, a field applied preservative should be used for all below grade portions of a new column. The process should then be repeated at the next column in line. Based on moisture readings taken at the site as a result of this investigation, it would be prudent to assume a minimum of 50% of the columns will require replacement. However, recommendations of this report would require further examination of the column bases by excavation to the bottom of the post to determine if column footings are present.
3. Purlins – In the existing classification, all purlins should be replaced or reinforced. The in-situ conditions suggest water infiltration has been taking place for some time. Although the truss system is capable of meeting the design snow load, calculations in Appendix C show that the purlins in the truss area are not adequate. To remediate, these areas should be reinforced with new 2x4 purlins screwed to existing 2X4 purlins. Field inspection showed the existing purlins in the stall area have extensive deterioration, and over half of all purlins in the stall area have some degree of decay.
4. Trusses – The individual trusses are adequate for Class A, B, & U, but the system of trusses must be modified with additional bracing in order to safely resist the design lateral loads. Continuous 2x4 top and bottom chord bracing must be installed the length of the structure at 1/3 points of the span (typically located at the panel points). In addition, end bay bracing and diagonal bracing at regular intervals will be required. The truss system sets on a 2x12 pine beam which is nailed to the column member.
5. Lateral system – The analysis and conclusion of the truss system highlights some actions for lateral support. However, there is no clear patch for lateral loads to be transferred from the structure to the foundation. Post Frame Design Manual suggests that the metal roof and exterior sheathing act as collectors to transfer loads to the column, and the buried portion of the column acts to partially fix the base. Using this methodology, the in place system is adequate for this type of structure, and consequently meets the code for all building classes.
6. Bathroom Facilities - Restrooms are not required under the IBC for a Class U structure, however the ADA requires accessible restroom facilities be available whenever a facility with non-accessible facilities is remodeled, and restrooms are needed under any development scenario whether it's for barn staff or others using the facility. In order to upgrade to a Class A-4 or B building use, the size and configuration of the bathroom facilities would require the loss of 2 or 4 horse stalls. In addition, the ADA would require other amenities for easy access to restroom facilities: concrete walkways, better lighting, hand rails, etc.
7. The following are electrical recommendations:

a. Installing GFCI receptacles for personal protection in the barn is required by current codes [2,3].
b. The grounding electrode system should be verified to be sufficient for the service and feeders that have been installed and added to over the years [3].
c. The locations of many of the electrical devices are places where the horses can come in contact with them and the potential of hazard increases with the moisture and dust content in the building [2,3]. New electrical design should avoid these problems.
d. The electrical panel in the barn has gaps where circuit breakers were removed. These locations need knock-out blanks installed in the cover to fill the gaps. [2,3]
e. The directory in the panel needs to be updated to show what each of the circuit breakers control [2,3].
f. Lighting fixture covers need to be installed to protect the public and horses from exploding glass debris and mercury filament.
g. Replace the existing wiring with code approved wiring [3].

8. In order for this structure to meet current code (due to the large square footage) for all respective Occupancy Classifications (A-4, B or U) the structure will be required to have a automatic sprinkler system (Dry-Pipe). A lighter weight sprinkler pipe could be used for a fire suppression system. However, detailed placement and material specification is critical for proper retro fit of this system into the existing structure to allow for gravity drainage.

While there were some obvious shortcomings from the construction of this structure, it has performed well for its intended use and has reached the end of its design life (25 to 30 years). Most existing shortcomings are due to water infiltration through the roof and walls. Any attempt to remediate the structural components for its present use without addressing the weather tightness of the building skin would be wasteful and result in a repeat of the current shortcomings. Upgrading the facility to exceed its intended use (Utility & Maintenance to Assembly or Business) is difficult and complex. Structurally, the complexity begins at the foundation level and permeates to the trusses and the roof itself. Since this is a public facility and public visitation exists through special riding programs, building upgrades would fulfill a public need. For instance, the present restroom facility is not ADA compliant and access to the present restroom would be challenging for wheelchair operation. Furthermore, by riding industry standards the arena is presently classified for training and practice [7]. Presently there are limited non-accessible accommodations for spectators, which fit the present classification and building use.

To upgrade the facility for competition and exhibition in accordance to the United States Equestrian Federation (USEF) would require increasing the width of the current arena. There are two sizes for Dressage Competition arenas: small and standard. The small arena is 20 m by 40 m (66x131 ft) and the standard arena is 20 m by 60 m (66x197 ft) [7]. The current arena does not meet the width requirement for either. The existing arena cannot be enlarged to accommodate the increased width requirement due to the truss span and support columns of the existing trusses (60ft).

G. COST:

1. The BLM cited 4 alternatives with associated costs [1]:
   a) Alternative 1 - Overhaul the existing Arena/Barn complex keeping the existing footing - $548,874.
   b) Alternative 1A – Alternative 1 plus replacing the metal roofing and siding and adding windows - $943,191.
   c) Alternative 2 – Overhaul the existing Arena/Barn complex, delete arena and reduce the footprint by almost half (42%). The arena function would be accomplished by constructing a separate new metal arena - $910,814.

d) Alternative 3 – Construct two metal building stables with new stalls at a difference location than the existing barn. Upon completion, demolish the existing barn/arena and construct a new arena - $1,235,266.

MEADOWOOD Preliminary Estimate Comparisons [1]				
DESCRIPTION	**ALT-1**	**ALT-1A**	**ALT-2**	**ALT-3**
ARENA/BARN				
Demolition			$49,891.00	$99,781.00
Structural-Truss bracing	$42,714.00	$42,714.00	$47,250.00	
Exterior Building Repairs	$55,485.00	$2,835.00	$33,615.00	
Exterior Site Repairs	$25,650.00	$25,650.00	$25,650.00	
Bathroom & Plumbing	$17,985.00	$17,985.00	$17,985.00	
Utility/Storage Rooms/Office	$10,463.00	$10,463.00	$10,463.00	
Sprinkler Sys. & Detection	$118,982.00	$118,982.00	$73,620.00	
Horse Stall - Replace Watering Sys	$64,222.00	$64,222.00	$62,618.00	
Horse Stall - New 12' by 12' Sys Stall			$66,447.00	
Electrical	$83,599.00	$83,599.00	$60,028.00	
Replace Existing Walls		$61,695.00		
Replace Roof		$297,633.00		
Add Windows		$8,775.00		
SUBTOTAL	$439,099.00	$754,553.00	$467,566.00	$99,781.00
Contingency @ 25%	$109,775.00	$188,638.00	$116,891.00	$24,945.00
TOTAL	$548,874.00	$943,191.00	$584,457.00	$124,727.00
New Stables A & B				$681,898.00
New Arena-Open			$211,635.00	$211,635.00
New Arena-Excl. (Add)			$72,153.00	$72,153.00
SUBTOTAL			$283,788.00	$965,686.00
Contingency @ 15%			$42,568.00	$144,853.00
TOTAL New Work			$326,357.00	$1,110,539.00
TOTAL for Rehab. & New	$548,874.00	$943,191.00	$910,814.00	$1,235,266.00

2. The County reviewed the BLM cost and factored in the present day cost with an adjustment for contingency costs. The breakdown on these costs are as follows:
   a) Alternative 1 - $557,980
   b) Alternative 1A - $958,840
   c) Alternative 2 - $938,100
   d) Alternative 3 - $1,300,590

MEADOWOOD PRELIMINARY COST ESTIMATE [3]					
COMPARSION FROM BLM 2008 REPORT					
ITEM	**DESCRIPTION**	**ALT-1**	**ALT-1A**	**ALT-3**	**ALT-4**
	SUBTOTAL FOR ALL RENOVATION WORK (June 2007 estimate)	$439,099.00	$754,553.00	$467,566.00	$99,781.00
	Contingency @ 15%	$65,860.00	$113,180.00	$70,130.00	$14,970.00
	SUBTOTAL FOR ALL NEW WORK (from June 2007 estimate)			$283,788.00	$965,686.00
	Contingency @ 10%			$28,380.00	$96,570.00
	TOTAL FOR REHAB & NEW WORK (2007 cost)	$504,959.00	$867,733.00	$849,864.00	$1,177,007.00
	Inflated to 2010 Cost using ENR Constr. Cost Index	$557,980.00	$958,840.00	$939,100.00	$1,300,590.00

3. POZ was tasked to review Alternative 1 and present costs associated with preserving the structure and meeting IBC 2006 standards for a Class U facility.
   a) The cost estimate below reflects the cost to carry out structural improvements to extend the life of the structural members roofing and siding 25 years :

DESCRIPTION	**UNIT**	**QUANTITY**	**UNIT COST**	**AMOUNT**
FOUNDATION & CARPENTRY				
FOUNDATION (100% for Code Compliant)	Each	176	$660.00	$116,160.00
QA	Hrs	704	$106.85	$75,222.40
Engineering	Hrs	70	$121.15	$8,480.50
ROUGH CARPENTRY:				
QA	Hrs	180	$106.85	$10,685.00
column replacement	LS	90	$250.00	$22,500.00
Truss - add bracing	LF	4,200	$0.85	$3,570.00
Purlins	SF	25,792	$1.00	$25,792.00
Beam reinforcement	MFB	1	$9,027.00	$9,027.00
rafters	EACH	20	$500.00	$10,000.00
Engineering	Hrs	90	$121.15	$6,057.50
Subtotal [10]			**Subtotal**	**$287,494.40**
Architectural				
QA	Hrs	200	$106.85	$21,370.00
building skin	SF	8,900	$3.00	$26,700.00
roofing	SF	27,060	$2.00	$54,120.00
Engineering	Hrs	100	$121.15	$12,150.00
Subtotal [10]			**Subtotal**	**$114,340.00**
Other				
Sprinkler System & Detection	LS	1	$129,690.38	$ 129,690.38
Septic System (Wastewater) Assuming elevated sand mound [10]	LS	1	$23,000.00	$23,000.00
Total				**$554,524.78**

b) To extend the life of the building and upgrade its use to A or B classification (including paving and concrete work for accessibility):

DESCRIPTION	UNIT	QUANTITY	UNIT COST	AMOUNT
FOUNDATION & CARPENTRY				
FOUNDATION (100% for Code Compliant)	Each	176	$660.00	$116,160.00
QA	Hrs	704	$106.85	$75,222.40
Engineering	Hrs	70	$121.15	$8,480.50
ROUGH CARPENTRY:				
QA	Hrs	180	$106.85	$10,685.00
column replacement	LS	90	$250.00	$22,500.00
Truss - add bracing	LF	4,200	$0.85	$3,570.00
Purlins	SF	25,792	$1.00	$25,792.00
Beam reinforcement	MFB	1	$9,027.00	$9,027.00
rafters	EACH	20	$500.00	$10,000.00
Engineering	Hrs	90	$121.15	$6,057.50
Subtotal [10]			**Subtotal**	**$287,494.40**
Architectural (not required if remediation is in place)				
QA	Hrs	200	$106.85	$21,370.00
building skin (based on sq. ft. of structure)	SF	8,900	$3.00	$26,700.00
roofing	SF	27,060	$2.00	$54,120.00
Engineering	Hrs	100	$121.15	$12,150.00
Subtotal [10]			**Subtotal**	**$114,340.00**
<u>Roads/Paving/Walkways</u>				
QA	Hrs	184	$106.85	$75,222.40
Engineering	Hrs	92	$121.15	$8,480.50
Concrete Curb	LF	0	$15.00	$0.00
Paving	SY	278	$25.00	$6,950.00
Concrete Sidewalk	SF	6,200	$7.50	$46,500.00
Pipe Bollards	EA	6	$300.00	$1,800.00
Subtotal [10]			**Subtotal**	**138,952.90**
<u>Other</u>				
QA	Hrs	960	$106.85	$75,222.40
Engineering	Hrs	480	$121.15	$8,480.50
Restrooms	Each	4	$ 6,350.00	$ 25,400.00
Utility Storage Room and Office	LS	1	$ 11,404.67	$ 11,404.67
Sprinkler System & Detection	LS	1	$129,690.38	$ 129,690.38
Watering System	LS	1	$ 70,001.98	$ 70,001.98
Electric	LS	1	$ 91,122.91	$ 91,122.91
Septic System (Wastewater) assuming elevated sand mound [10]	LS	1	$44,000.00	$44,000.00
Sub-Total [1]			**Subtotal**	**$455,322.84**
<u>Total</u>				**<u>$896,110.14</u>**

H. REFERENCES

1. Alternatives for Arena/Stable Rehabilitation Meadowood Special Recreation Management Area, Lorton, VA, OC Project No. AE-ES-007, US DOI BLM, Denver CO, April 2008.
2. Horse Barn Assessment, POZ Environmental, LLC, Pittston, PA, Contract No. L10PA00209, Task 1, December 2010.
3. Barn/Arena Assessment, DPW & Environmental Services, Fairfax County, VA, December 2010.
4. International Building Code 2006, International Code Council, Inc., Country Club Hills, IL, 2006.
5. Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, American Society of Civil Engineers, 2010.
6. NDS 2005, National Design Specification for Wood Construction,
7. *United States Equestrian Federation www.**usef**.org/documents/ruleBook/2011/13-EV.pdf*
8. American Wood Council – Design for Code Acceptance of Post Frame Buildings.
9. The Post-Frame Design Manual, National Frame Builders Association.
10. R.S. Means Building Construction Cost Data, 63rd Annual Edition, 2009
11. Fairfax County, VA County Codes, 1976, Chapter 61.

I. BIBLIOGRAPHY

1. Mr. Posluszny has 32 years of experience as a Contracting Officer Representative, Project Manager, Project Engineer, and Principle Investigator for hundreds of Phase 1 studies. He is proficient in AutoCAD (Map 3D and Civil) and Microsoft Professional (Access, Excel, Word, PowerPoint). Mr. Posluszny has authored and co-authored 8 professional publications. Mr. Posluszny holds a Bachelor of Science degree from Wilkes University, Wilkes-Barre, PA in Environmental Science and Environmental Engineering. He has professional engineering licensure in Pennsylvania, New Jersey, and ACEES (in-progress).
2. Mr. Kelly has over 15 years of professional engineering experience, and is highly respected by architects, contractors and his peers. He is known best for his ability to work in a team environment throughout the design process, and he is well-versed in many complex engineering and field related issues. His responsiveness and ability to address challenges with a calm and organized demeanor is a valuable asset to every project. Mr. Kelly's background in structural engineering design and analysis stems from one of the most prestigious engineering programs in the country. He is an expert with Ram-Advance, Ram-Frame, RISA-3D, AutoCAD Revit Structure, and many other engineering software programs. During his impressive career, Jeff has been the Project Manager/Lead Structural Engineer for major building projects throughout the country for clients such as; Novartis Pharmaceuticals, Duke University, Penn State, New York City Health & Hospitals Corporation, L'Oreal. His portfolio or work includes major hospitals & research facilities, university student housing, office buildings, historic preservation work, K-12 schools, federal government buildings and other institutional/commercial projects. Mr. Kelly holds a Bachelor of Civil Engineering with an Emphasis in Structural Engineering from Lehigh University, Bethlehem, PA, and is a professional licensed engineer with over 16 years of professional experience.
3. Mr. Bowen is the Structural Engineer of Record for major building projects throughout the mid-Atlantic United States. His portfolio includes a wide array of building types—including many projects having construction costs in excess of $30million—and several beyond $100million. In addition to new buildings, Marc is very experienced with major renovations, additions and in solving unique structural engineering challenges. He is well-versed in all forms of construction including; structural steel, cast-in-place concrete, wood & heavy timber, light-gage metal framing, pre-cast concrete, conventional and deep foundations, masonry and historic structures. Mr. Bowen's success in the

architectural community stems from an internal drive to seek innovative and cost effective solutions to complex engineering issues. This, together with his high technical competency, and a background with construction field experience regularly aids the overall design team in steering many difficult and challenging projects to success. Building types in Mr. Bowen's portfolio includes; hospitals, research laboratories, corporate headquarters, hotels, apartment buildings & dormitories, K-12 public/private schools, private residences, athletic stadiums and major additions/renovations. Mr. Bowen holds a Bachelor of Architectural Engineering – Emphasis in Structural Engineering (BAE) from the Pennsylvania State University, University Park, PA, and has Professional Engineer licensure in New York, New Jersey, Pennsylvania, North Carolina, Puerto Rico, Alabama, Ohio, and West Virginia. Mr. Bowen and is NCEES Certified.

4. Mr. Ling is a Structural Engineer with 10 years experience in the inspection and design of highway bridges and associated structures. He has worked on various projects including design/build projects, where his responsibilities included structure design, and shop drawing review. He is familiar with the National Bridge Inspection Standards, the AASHTO "Manual for Maintenance Inspection of Bridges," and VDOT bridge safety inspection policies and procedures. Mr. Ling holds a B.S. degree from the Pennsylvania State University in Civil Engineering, and is a professional engineer since 2005.
5. Mr. DeAngelo has 15 years of professional experience in land surveying and environmental engineering. Mr. DeAngelo is proficient in AutoCAD Map 3D, Carlson Civil, and Microsoft Professional (Access, Excel, Word, and PowerPoint). He has valuable expertise in such instrumentation as: STATIC GPS, RAPID STATIC GPS, RTK GPS SURVEY JAVAD, and ROBOTIC SURVEYOR TOPCON. He has surveyed hundreds of sites to include site layout for construction, property easements, sub-divisions, line surveys, and others types of scenarios. He has also developed his expertise through seminars and conferences. Mr. DeAngelo holds a B.S. degree in Environmental Engineering from Penn State University, an A.S. degree in Surveying from Penn State University, and possesses licensure as a Professional Land Surveyor and is certified in the fundamental of engineering as an Engineer-In-Training (EIT).

APPENDIX A
Figures

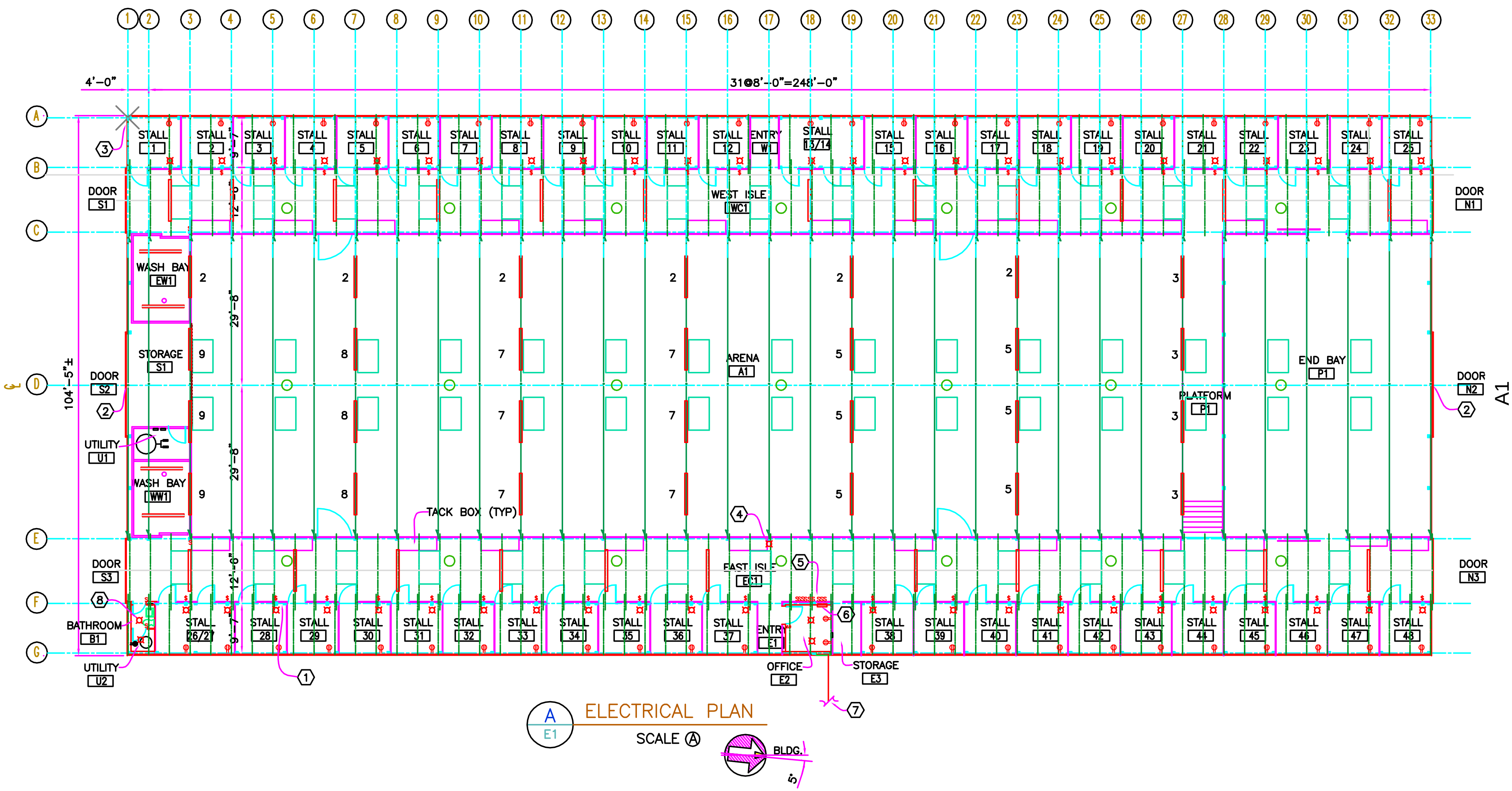


Figure # 1 - Coordinate System of Sampling Points.

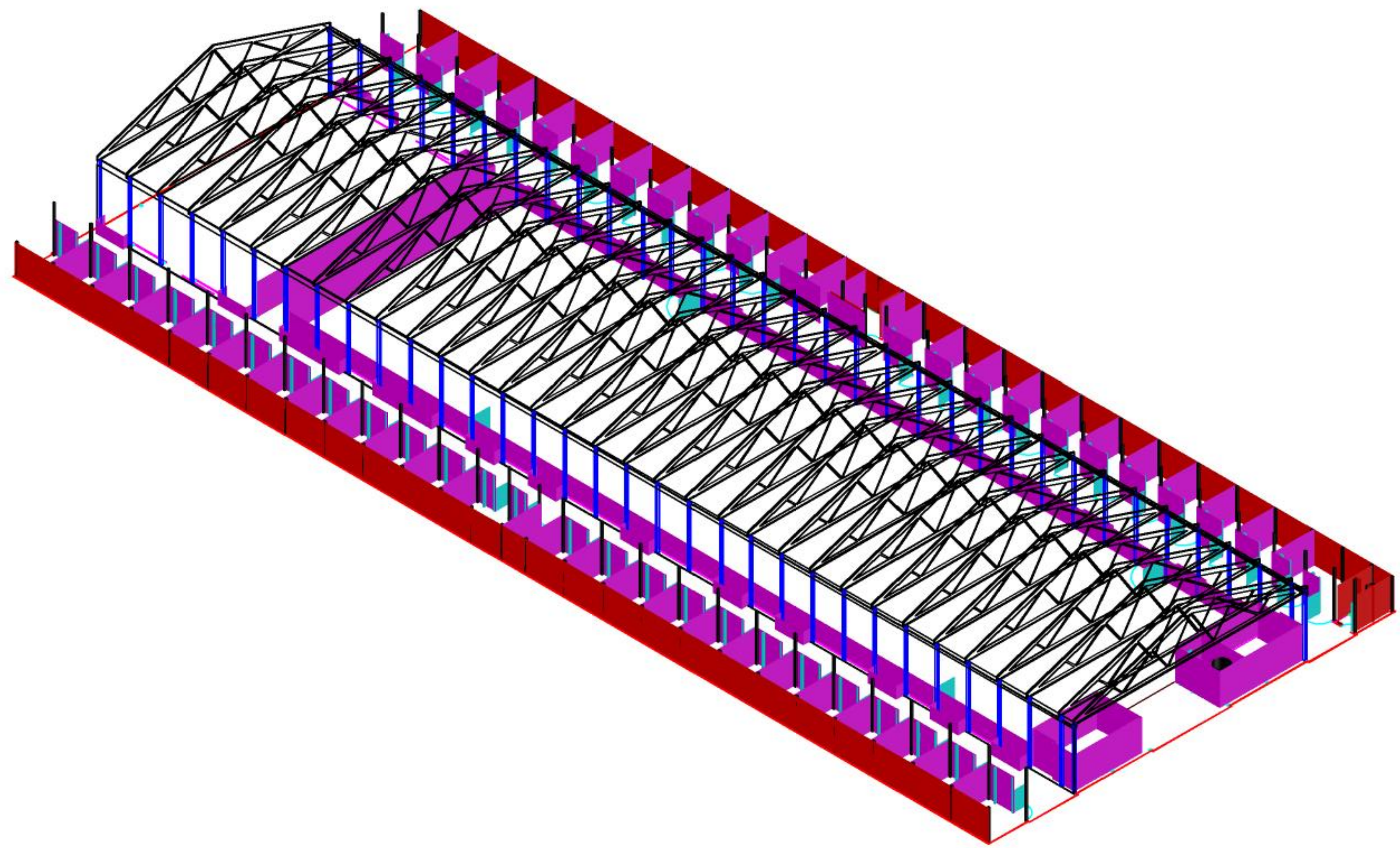


Figure 2 – Orthographic 3–D view from survey data of barn looking NE

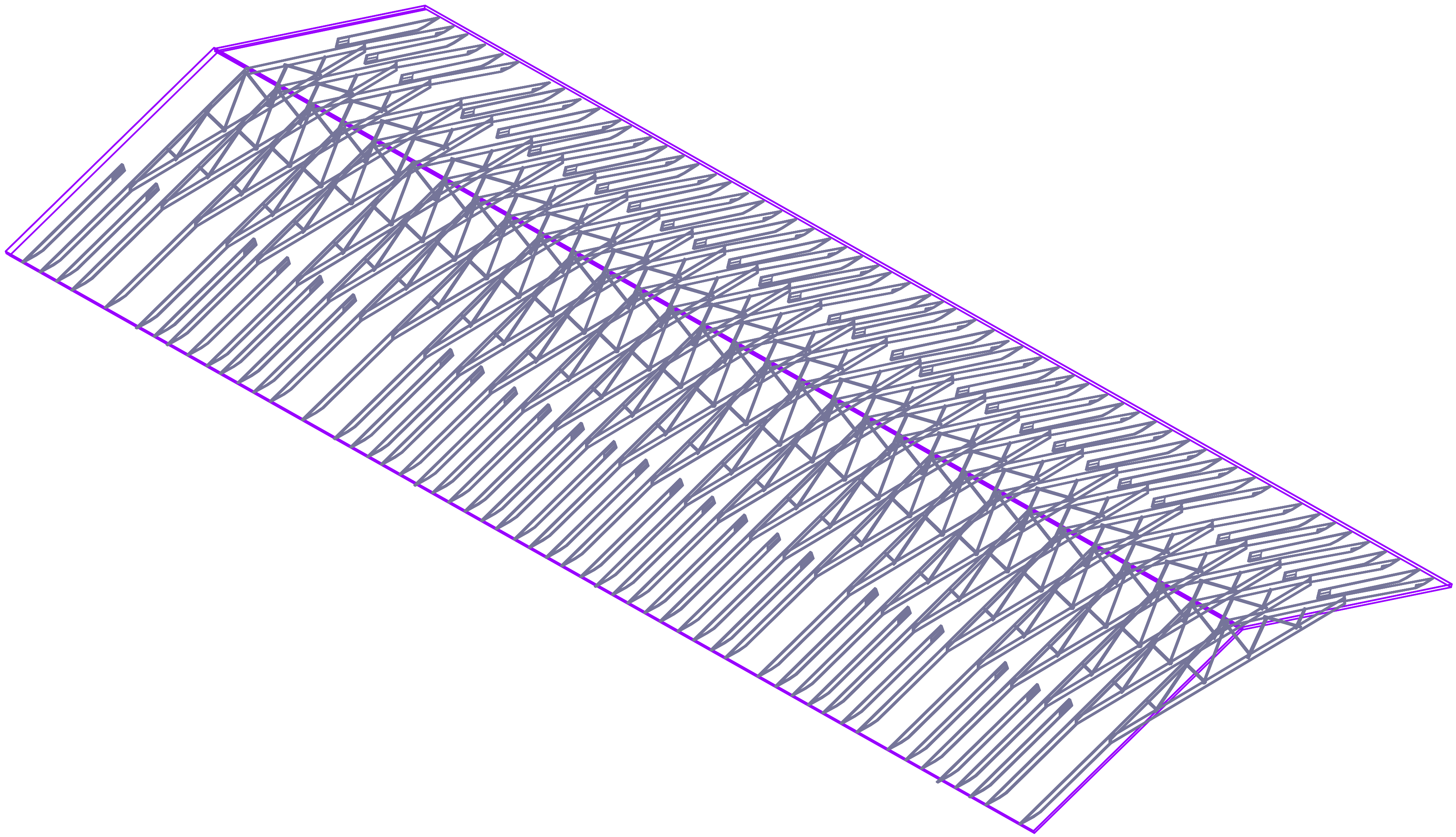


Figure # 3 - Scanned 3-D Image of Barn showing truss system.

Figure #4 - Photographs of Columns below ground level.

1D on West Side

2G

3A

4B

5C

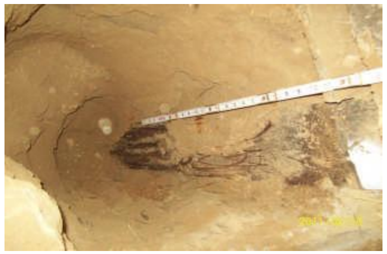
5E

7F

8C

8E

10A



11B

11C

Figure #4 - Photographs of Columns below ground level (continued).

11E

12G

14F

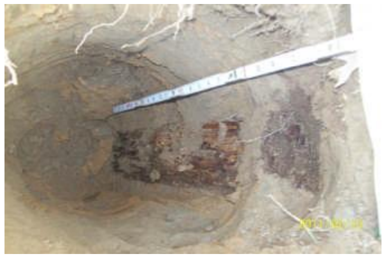
15G

16E

17C

19C

20A



23E

Figure #5 - Photographs of Purlins and Trusses


Span 2-3


Span 2-3


Span 3-4


Span 5-6


Span 5-6


Span 5-6


Span 9-10


Span 9-10


Span 9-10

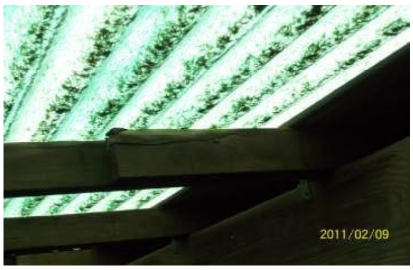

Span 9-10


Span 10-11


Span 10-11


Span 12-13


Span 12-13


Span 16-17


Span 20-21


Span 20-21


Span 20-21

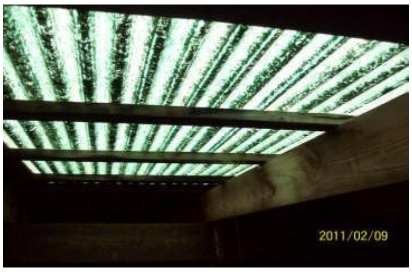
Figure #5 - Photographs of Purlins and Trusses (continued).

Span 20-21

Span 20-21

Isle Span

Span 25-26 on East Side



Sky Light looking to Apex

Typical Purlin Configuration from Apex

Typical Purlin Configuration in Sections A-C & E-G

Typical Purlin Configuration in Sections C & E

APPENDIX B

Table #1a - Column Inspection within the Arena of the Barn.

	Columns on East side of Arena (E)				***Columns on West side of Arena "C"***				
	% Soil Moisture				***% Soil Moisture***				
Location	**6"**	**12"**	**18"**	**24"**	**6"**	**12"**	**18"**	**24"**	
1		30	30	60	10	20			
2		60			1	60			
3	60	100			1	80			
4	50				50				
5	10	10	80		10	1	100		
6	70				1	1	1	20	
7	5	80			50	90			
8	40	99	60		60	5	60	100	
9		40	20	90	5	5	40	100	
10	30	100			10	50	2		
11	20		100		95	95			
12	20	0	0	40	50	2	40		
13	20	40							
14	70	0			5	1	30	80	
15	10	10	40		75				
16	21	55	95		60				
17	10	2	80			80d			
18	70	20			60d	75d			
19	60	100			10d	75d			
20	50	40	0	80					
21					80				
22	10	10	40		35	1	20		
23	90	60	50		50	1	100		
24	60	20	80	60	20	1	1	20	
25	20	60			1	20	60	80	
26	70	2	40	80	1	60	10	80	
27	10				60	100			
28	1	80			1	80			
29	20				70	1			
30	20	80			20	100			
31	20	30			80	100			
32	4	1	1	100	5	70			
33	10	10	20	63	50	20	10	70	

	Columns on East side of Arena, "E"					***Columns on West side of Arena, "C"***				
	% Wood Moisture					% Wood Moisture				
Location	**Above Grade**	**6"**	**12"**	**18"**	**24"**	**Above Grade**	**6"**	**12"**	**18"**	**24"**
1										
2										
3										
4										
5	13.6-15	>30	>30	>30	>30	13.6-15	>30	>30	>30	>30
6										
7										
8	12.1-13.5	>30	>30	>30	>30	13.6-15	>30	>30	>30	>30
9										
10										
11	13.6-15	>30	>30	>30	>30	12.1-13.5	>30	>30	>30	>30
12										
13										
14										
15										
16	12.1-13.5	>30	>30	>30	>30					
17						13.6-15	>30	27.6-30	>30	>30
18										
19	12.1-13.5	>30	>30	>30	>30	12.1-13.5	>30	>30	>30	>30
20										
21										
22										
23										
24										
25										
26	12.1-13.5	>30	>30	>30	>30	12.1-13.5	>30	>30	>30	>30
27										
28										
29										
30										
31										
32										
33										

SR - Severe Rot throughout
R - Rot on Surface
r - Beginning signs of rot

Table #1b - Column Inspection along the Horse Stalls within the Barn.

	Columns on East side of Stalls - "F"				*Columns on West side of Stalls, "B"*					*Columns on East side of Stalls, "F"*					*Columns on West side of Stalls, "B"*				
	% Soil Moisture				**% Soil Moisture**					**% Wood Moisture**					**% Wood Moisture**				
Location	**6"**	**12"**	**18"**	**24"**	**6"**	**12"**	**18"**	**24"**		**Above Grade**	**6"**	**12"**	**18"**	**24"**	**Above Grade**	**6"**	**12"**	**18"**	**24"**
1	1	5	1		1	20	60												
2																			
3																			
4	10	20	100												12.1-13.5	>30	>30	>30	>30
5																			
6																			
7										15.1-16	>30	>30	>30	>30					
8																			
9	5	70																	
10																			
11															12.1-13.5	>30	>30	>30	>30
12																			
13																			
14	60	100								12.1-13.5	>30	>30	>30	>30					
15																			
16																			
17																			
18																			
19	1	80													12.1-13.5	>30	>30	>30	>30
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27										12.1-13.5	>30	>30	>30	>30					
28																			
29																			
30																			
31																			
32															12.1-13.5		>30	>30	>30
33																			

SR - Severe Rot throughout
R - Rot on Surface
r - Beginning signs of rot

Table #1c - Column Inspection along the North and South ends of the Barn.

	Columns on South end of Barn, (1)				***Columns on North end of Barn, (33)***				***Columns on South end of Barn, (1)***					***Columns on North end of Barn, (33)***				
	% Soil Moisture				***% Soil Moisture***				**% Wood Moisture**					**% Wood Moisture**				
Location	**6"**	**12"**	**18"**	**24"**	**6"**	**12"**	**18"**	**24"**	**Above Grade**	**6"**	**12"**	**18"**	**24"**	**Above Grade**	**6"**	**12"**	**18"**	**24"**
D	1	1	1	30	80	45	18	20		>30	>30	>30	>30					
G	20	10	1	40	55	20	5	85						10.1-11	>30	>30	>30	>30
A	1	20			30	70	70							11.1-12	>30	>30	>30	>30
E	20	70	1	100	20	5	40											

SR - Severe Rot throughout
R - Rot on Surface
r - Beginning signs of rot

Table #1d - Column Inspection along the Exterior of the Barn.

	Columns on East side of Exterior, "G"				*Columns on West side of Exterior, "A"*				*Columns on East side of Exterior, "G"*						*Columns on West side of Exterior, "A"*				
	% Soil Moisture				*% Soil Moisture*				% Wood Moisture						% Wood Moisture				
Location	**6"**	**12"**	**18"**	**24"**	**6"**	**12"**	**18"**	**24"**	**Above Grade**	**6"**	**12"**	**18"**	**24"**		**Above Grade**	**6"**	**12"**	**18"**	**24"**
1	10				2	2	2	10											
2	20	10	12	15	20	20	20	40		>30	>30	>30	>30	SR					
3	5	2	17														>30	>30	>30
4	10	10																	
5	20	20	10																
6	35	5	20																
7	10	5	20																
8	10	10	42		5	95													
9	5	10			2	10	20												
10	5	10	10	30	2	20										>30	>30	>30	>30
11	5	5	40		2	20													
12	10	5	40		5	20				>30	>30	>30	>30	SR					
13	7	5	30		10	35													
14	5	40			7	60													
15					20					>30	>30	>30	>30	R					
16					5	15													
17					5	15													
18	5	10	40		5	25													
19	10	30			5	10	40												
20	10	20			20	40											>30	>30	>30
21	5	10			5	100													
22	20	40			5	10	15												
23	5	35			5	55				>30	>30	>30	>30	r					
24	5	5	20		5	10													
25	5	20			5	25											>30	>30	>30
26	5	5	35		5	20													
27	10	10	30		10	5	20												
28	20	10	35		10	5	5	20											
29	20	5	35		10	5	5	55											
30					5	5	5	35											
31					5	2	5	20											
32	20	40	55		5	10													
33					5	5	20	30		>30	>30	>30	>30		12.1-13.	>30	>30	>30	>30

SR - Severe Rot throughout
R - Rot on Surface
r - Beginning signs of rot

Table #2 - Purlin and Truss Inspection from line A to G and 1 to 33 of the Barn.		
Arena		Note Book
Span	**Description (use of a 2-man lift)**	Page
2-3	Approximatley 10 purlins show staining and slight beginning of rot near overlap and apex (typical).	24
3-4	Approximatley 10 purlins stained from moisture on the surface and minor rot in overlap, one purlin split, 12.1-13.5% moisture in purlins and truss, roof sheeting well fastened.	24
5-6	Similar to 3-4, 2x4 web member (isolated) deterorated from dry rot, nail in purlin chipped (isolated), bird nest in roof vent	24
9-10	Similar to 3-4, 12.1-13.5% moisture content in purlins and trusses, truss and web members split (photo taken).	24
10-11	Fourth purlin from apex split (3 feet long by 1/2 to 1/4 inch wide).	24
12-13	Two purlins split, one badly; periodic nailing missing maybe causing staining & slight rot.	24
16-17	Similar to 3-4; 12.1-13.5% moisture content; purlins simpson fasterners look good, no nails backed out; diagram in note book -typical purlin spacing is 2 feet with exception of 3 at 1'4" near apex; typical span of purlin is 8 feet from trusses.	25
19-20	Similar to typical	25
20-21	One purlin is rotted, complete section loss (see photo)	25
23-24	Similar to typical; isolated rot at end of purlin; splitting	26
25-26	Similar to typical; minor split in truss pieces	26
Stalls		Note Book
Span	**Description**	Page
2-3 East	Purlins at roof's edge severly rotted; nearly full section loss in one area; concerntated higher mositure ares 19.1-20% and >30%; rafters in good shape 9.1-10% moisture content; typical spacing is 2 feet on-center with a 4-foot span.	27
5-6 East	Signs of rot; medium to servere on purlins; typical 3 purlins closest to outer wall is worst shape.	27
10-11East	6" to 10" medium to severe rot on first three purlins	28
25-26 East	Two feet and end of rafter severely rotted	28
31-33 East	Additional rafter added to supplement rotted exterior one.	28
Gen note	In stalls half of purlins show rot; should consider replacement especially outer purlins	28
Note	North and south side of barn first 1' to 6", most purlins show signs of rot	28
Note	West side of barn similar to east side.	28
	East = E,F,and G	
	West = A, B, and C	
	Doorway numbering system	
	Apex = D	
	Nailing refers to roof sheeting	

APPENDIX C

MIDLANTIC ENGINEERING

TRANSMITTAL NOTICE

February 17, 2011

PROJECT NAME: (#11018) Materials Testing Services - 2011

TO: POZ Environmental
P.O. Box 663
Pittston, PA 18640

ATTENTION: Mr. Emanuel T. Posluszny, P.E.

Please find enclosed the results of the laboratory testing performed on the soil sample delivered to our office on February 11, 2011.

The sample from the Lower Potomac Field Station project was tested for gradation and classification, liquid & plastic limits, and natural moisture. The results of this testing are included herein as Enclosure (1).

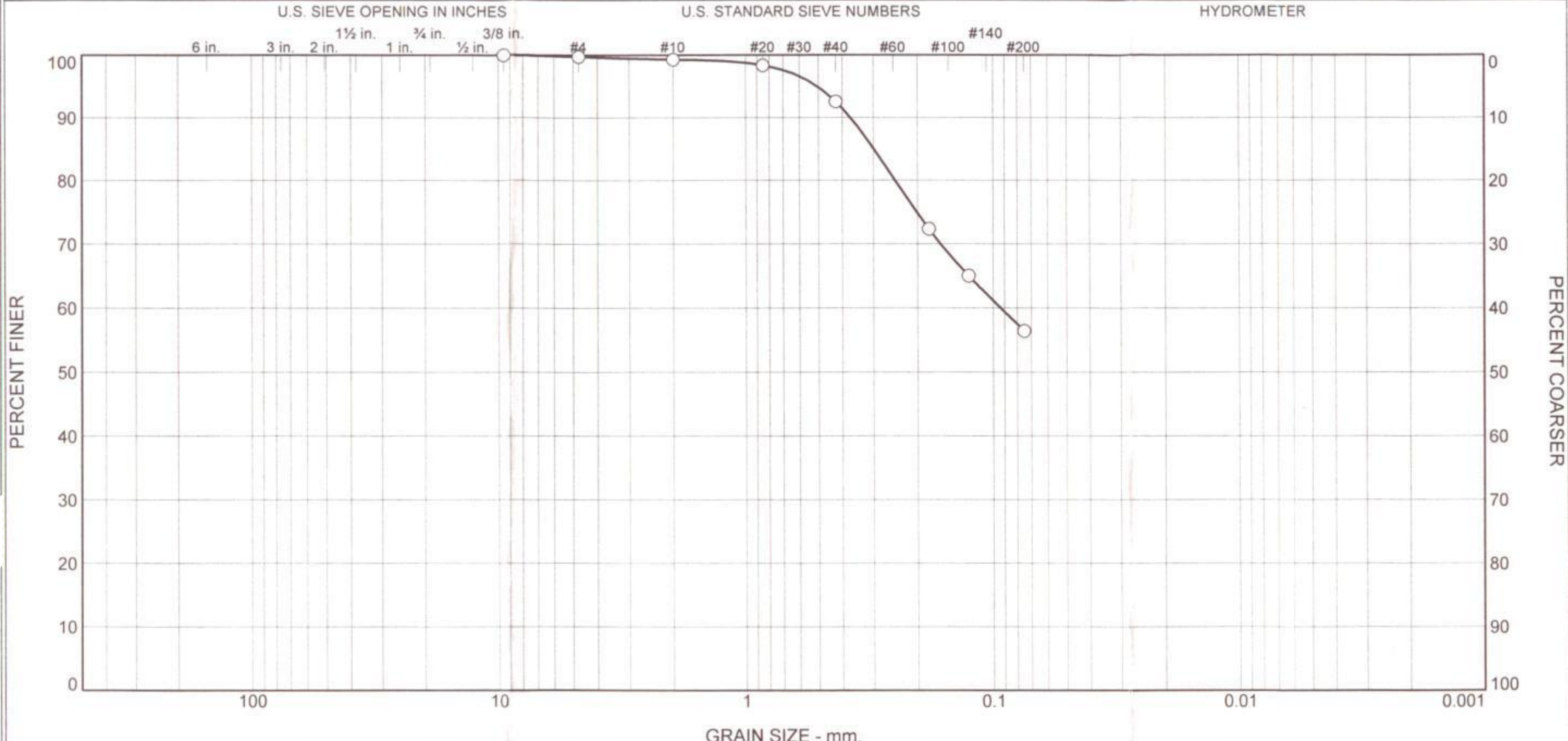
If you have any questions, please contact our office.

Submitted:
Timothy Burns, P.E.
President

Encls:
(1) Sample No. 1 (Southside House Barn)
- Gradation and Classification

120 Commerce Road • Pittston Twp., PA 18640-9552 • 570/655-2200 (phone) • 570/655-2212 (fax)

GRADATION AND CLASSIFICATION (ASTM D2487)



% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
○ 0.0	0.0	0.3	0.4	6.8	36.1	56.4	

Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○ Southside House Barn	S-1		2/11/11	CL-ML	brown sandy SILTY CLAY	16.0	22	17

Client POZ Environmental
Project Lower Potomac Field Station
Project No. 11018

MIDLANTIC ENGINEERING
Pittston Township, Pennsylvania

○ Plasticity Index PI= 5

PENNSTATE

School of Forest Resources
The Pennsylvania State University
111 Forest Resources Lab
University Park, PA 16802

Phone: 814/863-1113
Fax: 814/865-3725

March 3, 2011

Greetings!

This letter is in response to the request from Emanuel Posluszny who contacted me to identify three pieces of wood in mid-February. All three pieces were identified as Southern Yellow Pine (SYP) by industry standards today. By industry standards, SYP is known as Hard Pine due to its heaviness and hardness. It is the densest and strongest amoung the commercially significant softwoods. True species identification other than SYP is almost impossible unless the actual species of the tree were known when sawn and or more indepth microscope work; there are at least nine species that fall into the SYP category. The wood of these species cannot be seperated reliably by individual species, so one general species, SYP, was created.

Sincerely,

Michael Powell
Research Assistant

Design for Code Acceptance 5

Post Frame Buildings

Introduction

Post-frame buildings are efficient structures whose primary framing system is comprised of wood roof trusses or rafters connected to vertical timber columns or sidewall posts. Secondary members such as roof purlins and wall girts support the exterior cladding and transfer vertical and horizontal forces to and from the post-frame. Figure 1 illustrates the components of a post-frame building.

The purpose of this document is to provide guidance to post-frame building designers for meeting the requirements of the International Building Code (IBC) and to confirm that a properly designed post-frame building is in fact code compliant.

The following chapters and headings correspond to those of the *IBC*:

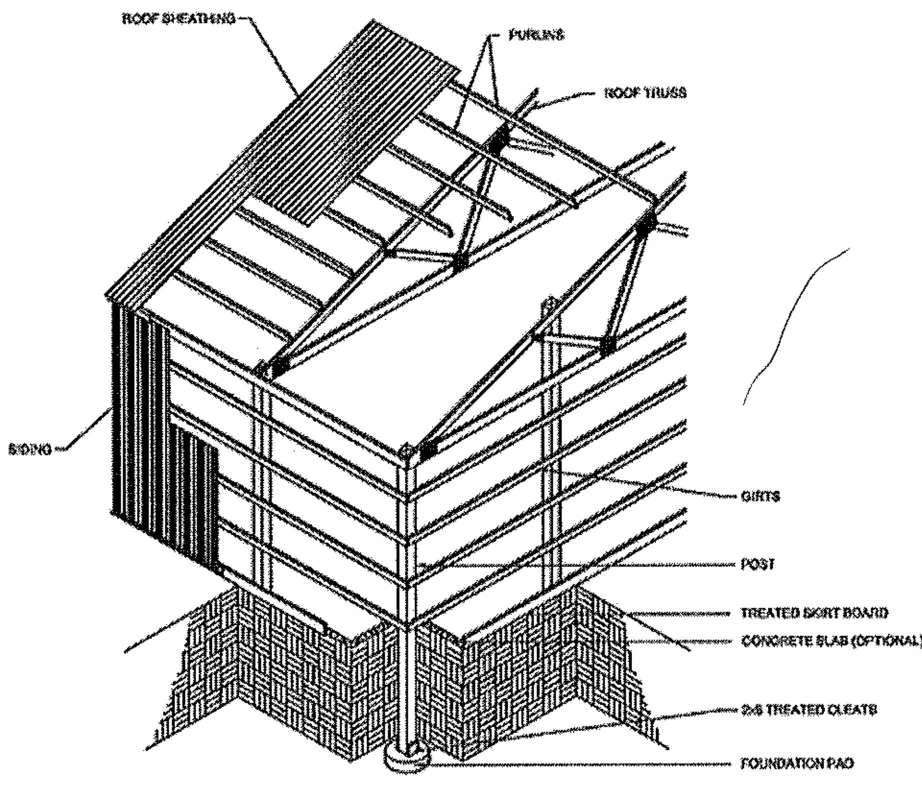


Figure 1 Components of a Post Frame Building

ma #6 PPBI.Com

Chapter 5 General Building Heights and Areas

Table 503 Allowable Height and Building Areas

Post-frame buildings are wood structures and as such are classified as Type V A or V B. The basic allowable height and area for each occupancy group is presented in the last two rows of Table 503. The allowable height may be modified in accordance with Section 504 and the allowable area may be modified in accordance with Section 506.

Chapter 6 Types of Construction

Table 601 Fire Resistance Rating Requirements for Building Elements

Per this table, there is no minimum required fire resistance rating of the elements of Type V B construction. With some exceptions (Notes 3 and 4), the minimum required fire resistance rating of the elements of Type V A construction is one hour. There is a report of a tested one-hour post-frame wall assembly available from the National Frame Builders Association (NFBA). A one hour roof ceiling assembly may be constructed with wood roof trusses in accordance with item 21-1.1 of Table 719.1c. Other systems are available from the Truss Plate Institute (TPI) and the Wood Truss Council of America (WTCA) as well as proprietary systems from the manufacturers of truss metal connector plates. A compendium of all known fire-rated truss assemblies is available from WTCA. There are many one hour assemblies for roofs built from dimensional lumber or engineered wood. Many of these can be found in DCA No. 3 - Fire-Rated Wood-Frame Wall and Floor/Ceiling Assemblies.

Table 602 Fire Resistance Rating Requirements for Exterior Walls Base on Fire Separation Distance

This table presents the minimum fire resistance rating for exterior walls based on occupancy group and fire separation distance. As previously mentioned, a report of a tested one-hour post-frame wall assembly is available from the NFBA. To date there is no tested assembly of a two hour or higher fire resistive post-frame wall. Where such requirements cannot be avoided, the designer may consider using a two hour rated stud wall assembly. DCA No. 3 - Fire Rated Wood Wall Assemblies describes how interior and exterior wood-frame walls can be used to meet building code requirements for fire resistive assemblies.

Chapter 7 Fire Resistive Materials and Construction

Table 704.8 Maximum Area of Exterior Wall Openings

This table presents the maximum allowable percentage of wall openings based on fire separation distance and fire classification of the opening.

Section 704.11 Parapets

A parapet is an extension of the wall above the roof line. In general, it is wise to avoid placing parapets along the eave line of post-frame buildings. Parapets at the eave increase the likelihood of roof leaks, and in cold climates will catch ice and snow. There are six exceptions provided in this Section.

Section 705.3 Exception

This Section allows fire walls in Type V Construction to be of combustible materials.

Chapter 12 Interior Environment

Section 1202.2 Attic Spaces

It is important that attics are ventilated in accordance with this section.

Chapter 13 Energy Efficiency

One of the benefits of post-frame construction is that it allows for economical super-insulated buildings. Attic spaces may be easily insulated with R-40 or higher materials. Because of their unique construction, post-frame walls may be easily insulated with R-30 batts. See Figure 2.

Chapter 14 Exterior Walls

Table 1405.2 Minimum Thickness of Weather Coverings

The most common exterior wall covering for post-frame buildings is pre-painted corrugated steel siding. But other materials such as exterior plywood, wood sidings, brick veneers, etc. are also common. This table provides the code prescribed minimum thickness for weather coverings.

Section 1405.10 Metal Siding

This section provides the requirements for metal sidings.

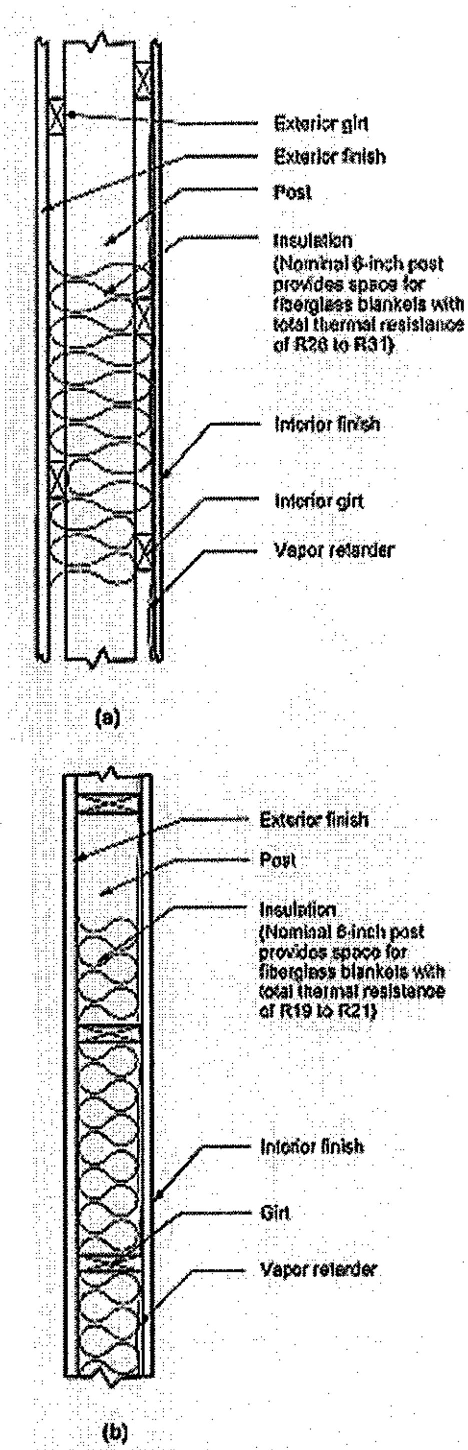


Figure 2 Typical post frame wall sections with (a) girts on exterior and interior of posts, and (b) girts between posts.

Section 1406 Combustible Materials on the Exterior Side of Exterior Walls

This section provides requirements for combustible sidings and Section 1406.2.4 provides fire blocking requirements.

Chapter 15 Roof Assemblies and Rooftop Structures

Section 1507.2 Asphalt shingles

Shingle and wood sheathed roofs are also common on post-frame buildings. Section 1507.2 provides the minimum code requirements for asphalt shingle roofs.

Section 1507.4 Metal roof panels

As with siding, the most common roof cladding for post-frame buildings is pre-painted corrugated steel. Section 1507.4 provides the minimum code requirements for metal roof panels. These steel roof systems are commonly used as horizontal diaphragms to transfer lateral loads from the post-frame to end and interior shear walls. When using a "floating" metal roof such as standing seam, it is essential to recognize that the "floating" roof does not provide a diaphragm, and to accommodate this during structural design.

Chapter 16 Structural Design Requirements

Post-frame buildings must be designed for structural requirements of this chapter, just as any other building.

Table 1604.3 Deflection Limits

One notable exception is to Table 1604.3 Deflection Limits. Experience has shown that purlins or girts supporting only corrugated metal cladding may be designed for stress only. Because of its inherent flexibility, corrugated metal will sustain no damage from extreme deflections parallel to its supports. If purlins or girts are used to support interior finishes in addition to metal siding, then they must meet the deflection limits of Table 1604.3.

Section 1604.8 Anchorage

Embedded posts must maintain a load path for uplift loads per the provisions of Section 1604.8.1. Note that dead load can be used to offset uplift as permitted in Section 1605.3.

Chapter 18 Soils and Foundations

The foundation system of a post-frame building is unique. The posts can be buried in the ground, embedded in concrete, or anchored to a concrete foundation.

In all cases the vertical loads from the roof are transferred to the column, and from the column to a concrete footing or foundation, and to the soil. Buried or embedded posts also can resist lateral loads by developing partial fixity. See Figures 3 and 4.

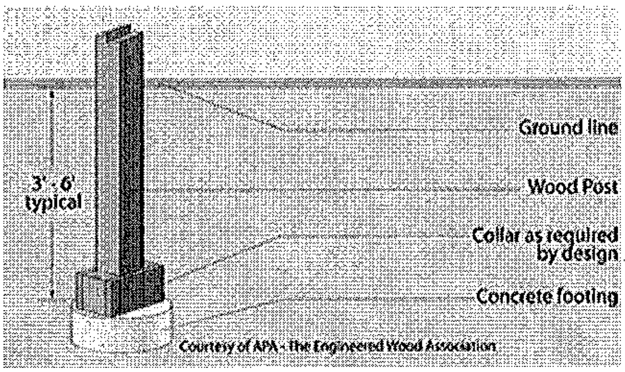


Figure 3 Post anchorage (post embedded) typical for solid-sawn columns

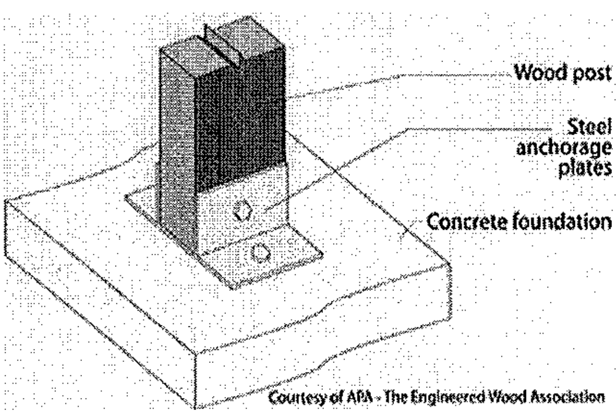


Figure 4 Post anchorage (post pinned) typical for glued-laminated columns

Section 1804 Allowable Load Bearing Values of Soils

The foundation system must be evaluated with respect to load bearing values of the soil. Section 1804 outlines those requirements.

Section 1805 Footings and Foundations

Standard practice for embedded posts is that a round hole is drilled for each post approximately four feet in the ground (or greater if required for frost protection per 1805.2.1). Either a pre-cast or cast in place round concrete pad is placed in the bottom of this hole. Pads are usually unreinforced. The diameter of this pad is determined so that the calculated vertical load in the post divided by the area of the pad is less than the allowable soil bearing pressure (per Sections 1804 and 1805). The foundation under an anchored post is designed conventionally. The minimum 28 day concrete strength is 2,500 psi per Section 1805.4.2.1.

Section 1805.7 Designs employing lateral bearing

Embedded posts can resist lateral loads through the development of partial fixity of the base. Research has shown that where the roof and side walls can act as diaphragms or shear walls, that the majority of the lateral loads will be resisted by them. The *Post-Frame Design Manual*, published by the National Frame Builders Association, as well as ANSI/ASAE EP 484, referenced in Section 2306.1, provide techniques for dividing the lateral loads among frames and diaphragms. After the design moments at the base of the posts have been determined, the embedment depth can be checked in accordance with Section 1805.7. A more extensive post embedment is treated more extensively in ANSI/ASAE EP 486.

Chapter 23 Wood

Section 2308.1 Preservative-treated wood

Preservative treated wood has been used successfully in contact with the ground for many years. The use of properly treated wood will provide assurance that a post-frame building will last for 50 years or more. This section and Section 1805.7 specify that wood posts shall be treated in accordance with American Wood Preservers' Association (AWPA) standard C2 or C4. Waterborne preservatives are the preferred method of treatment for wood in contact with the ground. The minimum waterborne treatment retention for posts in post-frame buildings is 0.6 pounds per cubic foot (pcf). Southern Pine has long been a preferred species for treatment because its cellular structure permits deep uniform penetration of the preservative.

Section 2303.4 Trusses

Metal plate connected wood trusses shall be designed and manufactured in accordance with ANSI/TPI 1. Appendix A to ANSI/TPI 1 is titled *Standard Design Responsibilities in the Design Process involving Metal Plate Connected Wood Trusses* (also known as WTCA 1). Every post-frame building designer should be familiar with this document, since trusses are normally purchased items based on the building designer's specifications. It is important that building designers understand their role in the design process relating to wood trusses. Additional information pertaining to design and installation of metal plate connected wood trusses is available from WTCA.

Section 2304.9 Connections and Fasteners

Structural lumber in a post-frame building is usually in a highly stressed state at design loads. Therefore, it is important that all connections between structural members be carefully designed by the post-frame building designer, not left to the discretion of the erector.

Section 2304.11 Protection against decay and termites

This section specifies the locations where wood is required to be preservative treated.

Section 2306.1 Allowable stress design

Post-frame design is normally based on allowable stress. The ANSI/ASAE standards cited in this section as well as the *Post-Frame Design Manual* published by the National Frame Builders Association, give guidance to the post-frame building designer

The information contained in this document is intended to assist the designer of post framed structures. Special effort has been made to assure that the information reflects the state of the art. However, the American Wood Council does not assume responsibility for particular designs or calculations prepared from this publication.

For additional information or assistance contact:

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803 Sycolin Rd, Suite 201
Leesburg, VA 20175
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202-463-2766

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SEE STATEMENT OF WORK FOR DESCRIPTION

PROJECT DATA

GROUND SNOW LOAD = P_g = 25 PSF

$P_f = .7\ C_e\ C_t\ I\ P_g$

$= .7(1)(1.2)(.8)(25)$

$= 16.8$ psf

Dead load
ROOFING = 2 psf
MEP = 2 psf
MISC = 1
5 psf

Sloped roof snow load (4.5-12 pitch)

$= .9(16.8)$

$= 15.2$ PSF

WIND SPEED = 90 mph

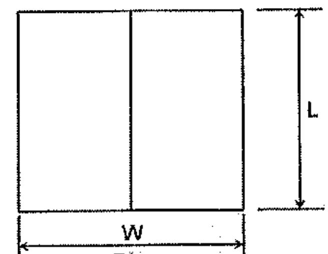
WIND LOADING ANALYSIS - MWFRS and Components/Cladding

Per ASCE 7-02 Code for Low-Rise, Enclosed Buildings with h <= 60' and Roof θ <= 45°
Using Method 1: Simplified Procedure (Section 6.4)

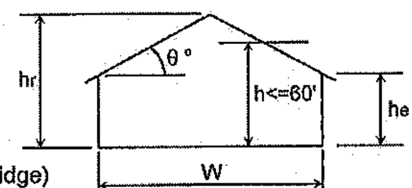
Job Name:	Meadowood Barn Analysis	Subject:	Barn Analysis		
Job Number:	2142.11	Originator:	jk	Checker:	mb

Input Data:

Wind Speed, V =	90	mph (Wind Map, Figure 6-1)
Bldg. Classification =	I	(Table 1-1)
Exposure Category =	D	(Sect. 6.5.6)
Ridge Height, hr =	26.00	ft. (hr >= he)
Eave Height, he =	15.00	ft. (he <= hr)
Building Width, W =	105.00	ft. (Normal to Building Ridge)
Building Length, L =	248.00	ft. (Parallel to Building Ridge)
Roof Type =	Gable	(Gable or Monoslope)
Wall C&C Name =	Wall	(Girt, Siding, Wall, or Fastener)
Wall C&C Eff. Area =	810.00	ft.^2 (for Component/Cladding)
Roof C&C Name =	Joist	(Purlin, Joist, Decking, or Fastener)
Roof C&C Eff. Area =	432.00	ft.^2 (for Component/Cladding)
Overhang Eff. Area =	0.00	ft.^2 (for Component/Cladding)



Plan



Elevation

Resulting Parameters and Net Design Pressures:

For Transverse Direction: (wind perpendicular to ridge)

Roof Angle, θ =	11.83	deg.
Mean Roof Ht., h =	20.50	ft. (h = he for θ < 10 deg.)
Adjustment Factor, λ =	1.556	(adjusts for height and exposure)
Importance Factor, I =	0.87	(Table 6-1)
Wall & Roof End Zone Width, a =	8.200	ft. (use: "2*a" for MWFRS, "a" for C&C)

Transverse MWFRS Net Pressures (psf)

Location	Direction	Zone	Load Case 1	Load Case 2
A = end zone of wall	Horizontal	A	20.42	---
B = end zone of roof	Horizontal	B	0.00	---
C = interior zone of wall	Horizontal	C	13.54	---
D = interior zone of roof	Horizontal	D	0.00	---
E = end zone of windward roof	Vertical	E	-20.85	---
F = end zone of leeward roof	Vertical	F	-13.07	---
G = interior zone of windward roof	Vertical	G	-14.48	---
H = interior zone of leeward roof	Vertical	H	-10.00	---

For Longitudinal Direction: (wind parallel to ridge)

Roof Angle, θ =	0.00	deg. (assumed)
Mean Roof Ht., h =	20.50	ft. (h = (hr+he)/2)
Adjustment Factor, λ =	1.556	(adjusts for height and exposure)

Longitudinal MWFRS Net Pressures (psf)

Location	Direction	Zone	Load Case 1	Load Case 2
A = end zone of wall	Horizontal	A	17.33	---
B = end zone of roof	Horizontal	B	0.00	---
C = interior zone of wall	Horizontal	C	11.51	---
D = interior zone of roof	Horizontal	D	0.00	---
E = end zone of windward roof	Vertical	E	-20.85	---
F = end zone of leeward roof	Vertical	F	-11.91	---
G = interior zone of windward roof	Vertical	G	-14.48	---
H = interior zone of leeward roof	Vertical	H	-9.21	---

(continued)

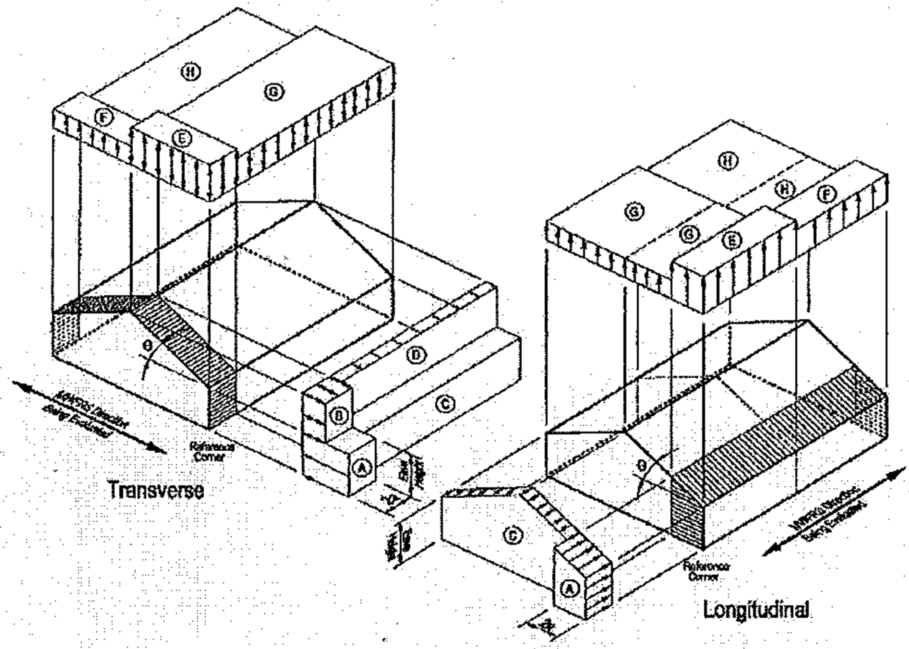
Total Design MWFRS Horizontal Load (kips)					
Transverse			Longitudinal		
Load Case 1	Load Case 2	Min. Load	Load Case 1	Load Case 2	Min. Load
53.76	---	64.48	27.96	---	21.53

Formulas:
Ph(Trans) = ((Pc*(L-4*a)+Pa*4*a)*he+(Pd*(L-4*a)+Pb*4*a)*(hr-he))/1000
Ph(Trans)(min) = P(min)*L*hr/1000 , where: P(min) = 10.0 psf on projected area
Ph(Long) = (Pa*(he+4*a/W*(hr-he)+he)/2*4*a+Pc*(W*(hr+he)/2-(he+4*a/W*(hr-he)+he)/2*4*a))/1000
Ph(Long)(min) = P(min)*W*(hr+he)/2/1000 , where: P(min) = 10.0 psf on full area

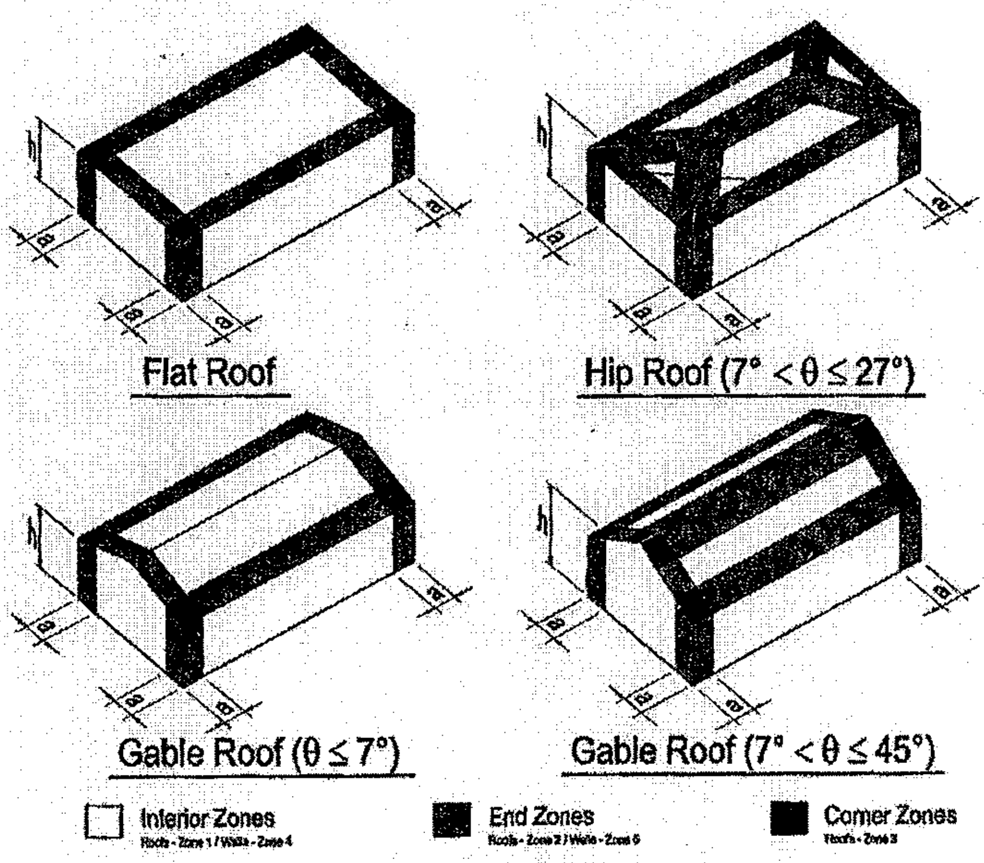
Components & Cladding Net Pressures (psf)				
Item	Location	Zone	Pos. (+)	Neg. (-)
Wall	4 = interior zone of wall	4	14.76	-16.38
	5 = end zone of wall	5	14.76	-16.38
Roof Joist	1 = interior zone of roof	1	7.99	-16.38
	2 = end zone of roof	2	7.99	-23.01
	3 = corner zone of roof	3	7.99	-36.42
Roof Overhang	2 = end zone of o.h.	2	---	---
	3 = corner zone of o.h.	3	---	---

Notes:
1. For Method 1: Simplified Procedure of Section 6.4 to be used for an enclosed low-rise building to determine the design wind loads, all of the following nine conditions of 6.4.1.1 must be met:
   a. Building is a simple diaphragm building, in which wind loads are transmitted through floor and roof diaphragms to the vertical Main Wind-Force Resisting System (MWFRS).
   b. Building is a low-rise building where mean roof height, h <= 60 ft., and h <= min. of L or W.
   c. Building is enclosed and conforms to wind-borne debris provisions of Section 6.5.9.3.
   d. Building is a regular shaped building, having no unusual geometrical irregularity.
   f. Building is not classified as a flexible building so it is considered "rigid".
   g. Building is not subject to across-wind loading, vortex shedding, etc.
   h. Building has no expansion joints or separations.
   i. Building is not subject to topographic effects, no abrupt topographic changes.
   j. Building has an approximately symmetrical cross section in each direction with either a flat roof, or gable roof with θ <= 45 degrees.
2. Wind pressures (ps30) in Figures 6-2 and 6-3 were prepared based on following assumptions:
   a. Mean roof height, h = 30 ft. , Exposure category = B , Importance factor, I =1.0
   b. Velocity pressure exposure coefficient, Kz = 0.70
   c. Directionality factor, Kd = 0.85 , Topographic factor, Kzt = 1.0
   d. Internal pressure coefficients, GCpi = +0.18, -0.18 (enclosed building)
   e. MWFRS pressure coeff's. from Figure 6-10, and C&C pressure coeff's. from Figure 6-11.
   f. Design wind pressure, $P_s = \lambda * I * p_{s30}$, in psf.
3. Design wind pressures are net pressures (sum of external and internal pressures).
4. Wall net pressure for MWFRS is total for both windward and leeward walls.
5. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.
6. If pressures for Zones "B" and "D" < 0, assume = 0.
7. For the design of the longitudinal MWFRS use roof angle, θ = 0 degrees.
8. Both load cases 1 and 2 are be checked for roof angle, 25 degrees < θ <= 45 degrees.
9. The total design MWFRS horizontal load is the total horizontal wind load on either the length (L) or the width (W) of the building respectively assuming one end zone of a width = 2*a.
10. Minimum wind load for MWFRS design shall be 10 psf applied on projected vertical plane. Minimum wind load for C&C shall be 10 psf acting in either direction normal to surface.
11. References:
    a. ASCE 7-02 Standard, "Minimum Design Loads for Buildings and Other Structures".
    b. "Guide to the Use of the Wind Load Provisions of ASCE 7-02" by: Kishor C. Mehta and James M. Delahay (2004).

(continued)



MWFRS - Wind Zones



Components and Cladding - Wind Zones

Total Design MWFRS Horizontal Load (kips)					
Transverse			Longitudinal		
Load Case 1	Load Case 2	Min. Load	Load Case 1	Load Case 2	Min. Load
53.76	---	64.48	27.96	---	21.53

Formulas:
Ph(Trans) = ((Pc*(L-4*a)+Pa*4*a)*he+(Pd*(L-4*a)+Pb*4*a)*(hr-he))/1000
Ph(Trans)(min) = P(min)*L*hr/1000 , where: P(min) = 10.0 psf on projected area
Ph(Long) = (Pa*(he+4*a/W*(hr-he)+he)/2*4*a+Pc*(W*(hr+he)/2-(he+4*a/W*(hr-he)+he)/2*4*a))/1000
Ph(Long)(min) = P(min)*W*(hr+he)/2/1000 , where: P(min) = 10.0 psf on full area

Components & Cladding Net Pressures (psf)				
Item	Location	Zone	Pos. (+)	Neg. (-)
Wall	4 = interior zone of wall	4	14.76	-16.38
	5 = end zone of wall	5	14.76	-16.38
Roof Joist	1 = interior zone of roof	1	7.99	-16.38
	2 = end zone of roof	2	7.99	-23.01
	3 = corner zone of roof	3	7.99	-36.42
Roof Overhang	2 = end zone of o.h.	2	---	---
	3 = corner zone of o.h.	3	---	---

Notes:
1. For Method 1: Simplified Procedure of Section 6.4 to be used for an enclosed low-rise building to determine the design wind loads, all of the following nine conditions of 6.4.1.1 must be met:
   a. Building is a simple diaphragm building, in which wind loads are transmitted through floor and roof diaphragms to the vertical Main Wind-Force Resisting System (MWFRS).
   b. Building is a low-rise building where mean roof height, h <= 60 ft., and h <= min. of L or W.
   c. Building is enclosed and conforms to wind-borne debris provisions of Section 6.5.9.3.
   d. Building is a regular shaped building, having no unusual geometrical irregularity.
   f. Building is not classified as a flexible building so it is considered "rigid".
   g. Building is not subject to across-wind loading, vortex shedding, etc.
   h. Building has no expansion joints or separations.
   i. Building is not subject to topographic effects, no abrupt topographic changes.
   j. Building has an approximately symmetrical cross section in each direction with either a flat roof, or gable roof with θ <= 45 degrees.
2. Wind pressures (ps30) in Figures 6-2 and 6-3 were prepared based on following assumptions:
   a. Mean roof height, h = 30 ft. , Exposure category = B , Importance factor, I =1.0
   b. Velocity pressure exposure coefficient, Kz = 0.70
   c. Directionality factor, Kd = 0.85 , Topographic factor, Kzt = 1.0
   d. Internal pressure coefficients, GCpi = +0.18, -0.18 (enclosed building)
   e. MWFRS pressure coeff's. from Figure 6-10, and C&C pressure coeff's. from Figure 6-11.
   f. Design wind pressure, $P_s = \lambda * I * p_{s30}$, in psf.
3. Design wind pressures are net pressures (sum of external and internal pressures).
4. Wall net pressure for MWFRS is total for both windward and leeward walls.
5. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.
6. If pressures for Zones "B" and "D" < 0, assume = 0.
7. For the design of the longitudinal MWFRS use roof angle, θ = 0 degrees.
8. Both load cases 1 and 2 are be checked for roof angle, 25 degrees < θ <= 45 degrees.
9. The total design MWFRS horizontal load is the total horizontal wind load on either the length (L) or the width (W) of the building respectively assuming one end zone of a width = 2*a.
10. Minimum wind load for MWFRS design shall be 10 psf applied on projected vertical plane. Minimum wind load for C&C shall be 10 psf acting in either direction normal to surface.
11. References:
   a. ASCE 7-02 Standard, "Minimum Design Loads for Buildings and Other Structures".
   b. "Guide to the Use of the Wind Load Provisions of ASCE 7-02" by: Kishor C. Mehta and James M. Delahay (2004).

(continued)

Project Name: MEADOWOOD BARN
Subject: TRUSS LOADING

Project Number:
Calculations: By:
Checked: By:
Sheet: of

reuther+bowen
Engineering, Design, Construction Services

516 North Blakely Street
Dunmore, PA 18512
Offices: NJ & NYC

v. 570.496.7020
f. 570.496.7021
e: info@reutherbowen.com
www.reutherbowen.com

TRUSS WILL BE ANALYZED USING
RAM - ELEMENTS

LOAD INPUT FOR TRUSS IS

TOP CHORD DL = 5psf (8'-0") = 40 lb/FT
LL = 15.2 (8'-0") = 120 lb/FT
(Duration = 2 months)

Bottom chord DL = 5psf (8'-0") = 40 lb/FT

Project Name: Meadowood Barn
Subject:

Project Number:
Calculations: By:
Checked: By:
Sheet: of

reuther+bowen
Engineering, Design, Construction Services

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LOAD INPUT FOR TRUSS DESIGN

TOP CHORD DL = 5psf (8'-0") = 40 lb/FT

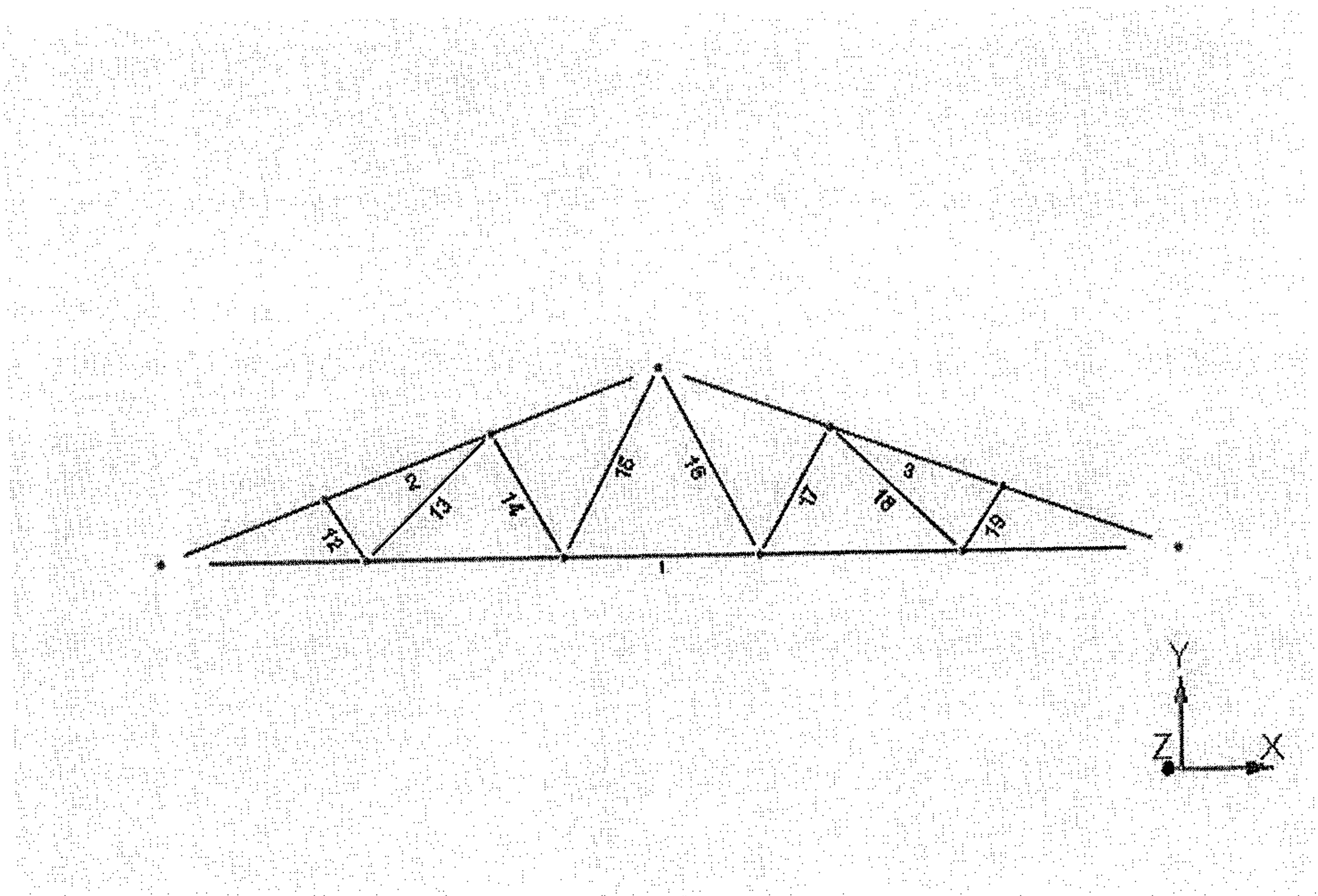
LL = 15.2 (8'-0") = 126 lb/FT

Bottom Chord DL = 5psf (8'-0) = 40 lb/FT

LOAD INPUT FOR TRUSS Purlin / ROOF + STALL Purlin

DL = 5psf X (2'-0) = 10 lb/FT
LL = 16.8 psf (2'-0) = 34 lb/FT

ALSO CHECK FOR 300# LOAD
@ MID SPAN



2
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Y
Z
X

Bentley Meadowood Barn Analysis

Current Date: April, 2011
Units system: English
File name: Meadowood truss analysis

Wood Design

Design code: AF&PA NDS-ASD-2005

Report: Comprehensive

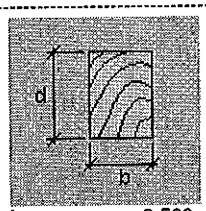
Member	:	**3**
Design status	:	**OK**

PROPERTIES

Section information

Section name: S4S 4x10 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	9.250	[in]	Height

Properties

Section properties	**Unit**	**Major axis**	**Minor axis**
Gross area of the section. (Ag)	[in2]	32.375	
Moment of Inertia (principal axes) (I')	[in4]	230.840	33.049
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	49.911	18.885

Material : SPine_No2

Properties	**Value**
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	**Unit**	**Value**
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Beam
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	**Unit**	**Major axis**	**Minor axis**
Physical length	[ft]	31.86	
Effective length for bending (Le)	[ft]	4.00	

Unbraced length for bending (Lu)	[ft]	2.00	
Unbraced compression length (Lx, Ly)	[ft]	11.00	2.00
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	31.86	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.04	S2 at 84.43%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.00			
Capacity	:	0.52 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.58	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.32			
Capacity	:	1.35 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	:	-0.43 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.78	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-13.91	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	2.34	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	10.14	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio	:	0.33			
Capacity	:	1.32 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.44 [Kip/in2]	Ctrl Eq.	:	D2 at 14.58%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.05	

Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	1.84	
Slenderness Ratio (RB)	--	6.02	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	19.20	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	1.14 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.05	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.10	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✓

Shear parallel to minor axis, V2

Ratio	:	0.24			
Capacity	:	0.20 [Kip/in2]	Reference	:	(Sec. 3.4)
Demand	:	0.05 [Kip/in2]	Ctrl Eq.	:	D2 at 66.67%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	1.04	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✓

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.36	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.35	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio : 0.51

Ctrl Eq. : D2 at 14.58%
Reference : (Eq. 3.9-3)

CRITICAL STRENGTH RATIO ✔

Ratio : 0.51
Ctrl Eq. : D2 at 14.58% Reference : (Eq. 3.9-3)

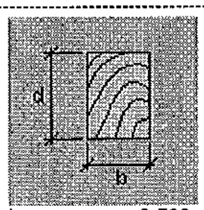
Member : 1
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x10 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	9.250	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	32.375	
Moment of Inertia (principal axes) (I')	[in4]	230.840	33.049
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	49.911	18.885

Material : SPine_No2

Properties	Value

Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Beam
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	59.83	
Effective length for bending (Le)	[ft]	22.82	
Unbraced length for bending (Lu)	[ft]	12.33	
Unbraced compression length (Lx, Ly)	[ft]	10.17	10.17
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	59.83	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.04	S2 at 65.69%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	: 0.60			
Capacity	: 0.66 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	: 0.40 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.58	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	12.80	

DESIGN FOR COMPRESSION ✔

Ratio	: 0.00			
Capacity	: 0.37 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)

Column stability factor (CP)	--	0.27	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	0.00	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	2.74	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	0.39	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✓

Bending about major axis, M33

Ratio	: 0.14		
Capacity	: 1.29 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	: 0.18 [Kip/in2]	Ctrl Eq.	: D2 at 21.25%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.05	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	0.97	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.76	
Slenderness Ratio (RB)	--	14.38	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	3.37	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	: 0.00		
Capacity	: 1.14 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.05	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.10	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✓

Shear parallel to minor axis, V2

Ratio	: 0.02		
Capacity	: 0.20 [Kip/in2]	Reference	: (Sec. 3.4)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D2 at 60.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.07	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (Informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.36	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.35	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	:	0.73			
			Ctrl Eq.	:	D2 at 80.00%
			Reference	:	(Eq. 3.9-1)

CRITICAL STRENGTH RATIO ✔

Ratio	:	0.73			
Ctrl Eq.	:	D2 at 80.00%	Reference	:	(Eq. 3.9-1)

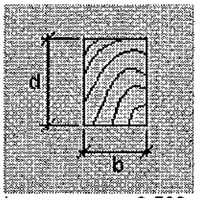
Member : 2
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x10 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	9.250	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	32.375	
Moment of Inertia (principal axes) (I')	[in4]	230.840	33.049
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	49.911	18.885

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Beam
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	31.86	
Effective length for bending (Le)	[ft]	4.00	
Unbraced length for bending (Lu)	[ft]	2.00	
Unbraced compression length (Lx, Ly)	[ft]	11.00	2.00
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	31.86	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.05	S2 at 84.43%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.00			
Capacity	:	0.52 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.58	

Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.32			
Capacity	:	1.35 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	:	-0.43 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.78	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-13.91	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	2.34	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	10.14	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio	:	0.33			
Capacity	:	1.32 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.44 [Kip/in2]	Ctrl Eq.	:	D2 at 14.58%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.05	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	1.84	
Slenderness Ratio (RB)	--	6.02	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	19.20	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	1.14 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.05	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.10	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.10	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)

Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✔

Shear parallel to minor axis, V2

Ratio	:	0.24		
Capacity	:	0.20 [Kip/in2]	Reference	: (Sec. 3.4)
Demand	:	0.05 [Kip/in2]	Ctrl Eq.	: D2 at 66.67%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	1.04	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00		
Capacity	:	0.16 [Kip/in2]	Reference	: (Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	:	0.00		
Capacity	:	0.11 [Kip/in2]	Reference	: (AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.36	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.35	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	:	0.51		
			Ctrl Eq.	: D2 at 14.58%
			Reference	: (Eq. 3.9-3)

CRITICAL STRENGTH RATIO ✓

Ratio	:	0.51			
Ctrl Eq.	:	D2 at 14.58%	Reference	:	(Eq. 3.9-3)

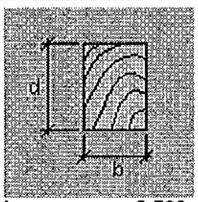
Member	:	**12**
Design status	:	**OK**

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	**Unit**	**Major axis**	**Minor axis**
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	**Value**
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	**Unit**	**Value**
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	**Unit**	**Major axis**	**Minor axis**
Physical length	[ft]	4.38	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	4.38	
Unbraced compression length (Lx, Ly)	[ft]	4.38	4.38
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	

Length between inflection points (Li)	[ft]	4.38

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.02	S2 at 100.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	: 0.00		
Capacity	: 0.74 [Kip/in2]	Reference	: (Sec. 3.8)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION ✔

Ratio	: 0.11		
Capacity	: 1.38 [Kip/in2]	Reference	: (Sec. 3.6.3)
Demand	: -0.15 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.73	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-1.82	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	2.12	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	2.12	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio	: 0.00		
Capacity	: 1.35 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)

Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	5.26	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	25.20	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	1.35 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✓

Shear parallel to minor axis, V2

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✓

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✓

Combined axial and bending interaction value

Ratio : 0.01

Ctrl Eq. : D2 at 0.00%
Reference : (Eq. 3.9-3)

CRITICAL STRENGTH RATIO ✓

Ratio : 0.11
Ctrl Eq. : D2 at 0.00% Reference : (Sec. 3.6.3)

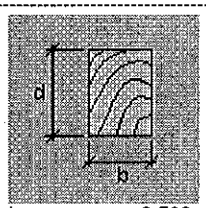
Member : 13
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b = 3.500 [in] Width
d = 3.500 [in] Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Beam
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	10.50	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	10.50	
Unbraced compression length (Lx, Ly)	[ft]	10.50	10.50
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	10.50	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.03	S2 at 0.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.17			
Capacity	:	0.95 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.16 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	1.99	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.00			
Capacity	:	0.35 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.23	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	0.00	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)

Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	0.37	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	0.37	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio : 0.00			
Capacity : 1.73 [Kip/in2]		Reference	: (Sec. 3.3)
Demand : 0.00 [Kip/in2]		Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	8.14	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	10.50	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio : 0.00			
Capacity : 1.35 [Kip/in2]		Reference	: (Sec. 3.3)
Demand : 0.00 [Kip/in2]		Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✔

Shear parallel to minor axis, V2

Ratio : 0.00			
Capacity : 0.20 [Kip/in2]		Reference	: (Sec. 3.4)
Demand : 0.00 [Kip/in2]		Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio : 0.00			
Capacity : 0.16 [Kip/in2]		Reference	: (Sec. 3.4.2)
Demand : 0.00 [Kip/in2]		Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	: 0.00		
Capacity	: 0.11 [Kip/in2]	Reference	: (AITC-TCM)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (Informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	: 0.17		
		Ctrl Eq.	: D2 at 0.00%
		Reference	: (Eq. 3.9-1)

CRITICAL STRENGTH RATIO ✔

Ratio	: 0.17		
Ctrl Eq.	: D2 at 0.00%	Reference	: (Sec. 3.8)

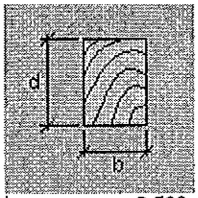
Member : 14
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	8.41	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	8.41	
Unbraced compression length (Lx, Ly)	[ft]	8.41	4.20
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	8.41	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.02	S2 at 100.00%	

DESIGN CHECKS

DESIGN FOR TENSION

Ratio	:	0.00			
Capacity	:	0.74 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)

Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.43		
Capacity	:	0.53 [Kip/in2]	Reference	: (Sec. 3.6.3)
Demand	:	-0.23 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.28	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-2.83	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	0.57	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	2.30	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio	:	0.00		
Capacity	:	1.73 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	7.28	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	13.12	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00		
Capacity	:	1.35 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✔

Shear parallel to minor axis, V2

Ratio	:	0.00			
Capacity	:	0.20 [Kip/in2]	Reference	:	(Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	:	0.19			
			Ctrl Eq.	:	D2 at 0.00%
			Reference	:	(Eq. 3.9-3)

CRITICAL STRENGTH RATIO ✔

Ratio	:	0.43			
Ctrl Eq.	:	D2 at 0.00%	Reference	:	(Sec. 3.6.3)

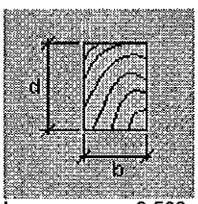
Member : 15
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	**Unit**	**Major axis**	**Minor axis**
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	**Value**
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	**Unit**	**Value**
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	**Unit**	**Major axis**	**Minor axis**
Physical length	[ft]	12.38	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	12.38	
Unbraced compression length (Lx, Ly)	[ft]	12.38	6.20
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	12.38	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.02	S2 at 0.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	: 0.25			
Capacity	: 0.95 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	: 0.23 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
<u>Axial design value for tension (Ft)</u>	[Kip/in2]	0.83	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
<u>Tension axial force (P+)</u>	[Kip]	2.86	

DESIGN FOR COMPRESSION ✔

Ratio	: 0.00			
Capacity	: 0.25 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
<u>Axial design value for compression (Fc)</u>	[Kip/in2]	1.65	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.17	(Eq. 3.7-1)
<u>Compression axial force (P-)</u>	[Kip]	0.00	
<u>Modulus of elasticity for stability (Emin)</u>	[Kip/in2]	580.00	
<u>Adjusted modulus of elasticity for stability (Emin')</u>	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
<u>Critical buckling design value (FcE1)</u>	[Kip/in2]	0.26	(Sec. 3.9.2)
<u>Critical buckling design value (FcE2)</u>	[Kip/in2]	1.06	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

<u>Bending about major axis, M33</u>

Ratio	: 0.00			
Capacity	: 1.73 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
<u>Bending design value (Fb)</u>	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)

Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	8.84	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	8.91	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00			
Capacity	:	1.35 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✔

Shear parallel to minor axis, V2

Ratio	:	0.00			
Capacity	:	0.20 [Kip/in2]	Reference	:	(Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio : 0.25

Ctrl Eq. : D2 at 0.00%
Reference : (Eq. 3.9-1)

CRITICAL STRENGTH RATIO ✔

Ratio : 0.25
Ctrl Eq. : D2 at 0.00% Reference : (Sec. 3.8)

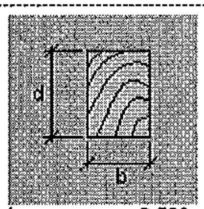
Member : 16
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	12.38	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	12.38	
Unbraced compression length (Lx, Ly)	[ft]	12.38	6.20
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	12.38	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.01	S2 at 0.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.25			
Capacity	:	0.95 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.23 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	2.86	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.00			
Capacity	:	0.25 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.17	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	0.00	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)

Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	0.26	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	1.06	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✔

Bending about major axis, M33

Ratio	:	0.00		
Capacity	:	1.73 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	8.84	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	8.91	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00		
Capacity	:	1.35 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✔

Shear parallel to minor axis, V2

Ratio	:	0.00		
Capacity	:	0.20 [Kip/in2]	Reference	: (Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00		
Capacity	:	0.16 [Kip/in2]	Reference	: (Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	:	0.00		
Capacity	:	0.11 [Kip/in2]	Reference	: (AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	:	0.25		
			Ctrl Eq.	: D2 at 0.00%
			Reference	: (Eq. 3.9-1)

CRITICAL STRENGTH RATIO ✔

Ratio	:	0.25		
Ctrl Eq.	:	D2 at 0.00%	Reference	: (Sec. 3.8)

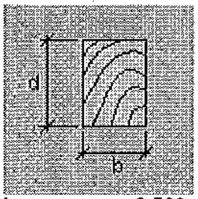
Member : 17
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	8.41	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	8.41	
Unbraced compression length (Lx, Ly)	[ft]	8.41	4.20
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	8.41	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.03	S2 at 100.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.00			
Capacity	:	0.74 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)

Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION

Ratio	: 0.43			
Capacity	: 0.53 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	: -0.23 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.28	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-2.83	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	0.57	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	2.30	(Sec. 3.9.2)

DESIGN FOR FLEXURE

Bending about major axis, M33

Ratio	: 0.00			
Capacity	: 1.35 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	7.28	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	13.12	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	: 0.00			
Capacity	: 1.35 [Kip/in2]	Reference	:	(Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR

Shear parallel to minor axis, V2

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00			
Capacity	:	0.16 [Kip/in2]	Reference	:	(Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION

Ratio	:	0.00			
Capacity	:	0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION

Combined axial and bending interaction value

Ratio	:	0.19			
			Ctrl Eq.	:	D2 at 0.00%
			Reference	:	(Eq. 3.9-3)

CRITICAL STRENGTH RATIO

Ratio	:	0.43			
Ctrl Eq.	:	D2 at 0.00%	Reference	:	(Sec. 3.6.3)

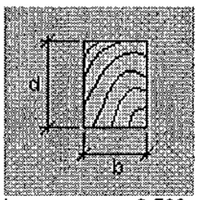
Member : 18
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Beam
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	10.50	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	10.50	
Unbraced compression length (Lx, Ly)	[ft]	10.50	10.50
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	10.50	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.03	S2 at 0.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✓

Ratio	:	0.17		
Capacity	:	0.95 [Kip/in2]	Reference	: (Sec. 3.8)
Demand	:	0.16 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	1.99	

DESIGN FOR COMPRESSION ✓

Ratio	:	0.00		
Capacity	:	0.35 [Kip/in2]	Reference	: (Sec. 3.6.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.23	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	0.00	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	0.37	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	0.37	(Sec. 3.9.2)

DESIGN FOR FLEXURE ✓

Bending about major axis, M33

Ratio	:	0.00		
Capacity	:	1.73 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)

Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	8.14	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	10.50	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	:	0.00		
Capacity	:	1.35 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR ✓

Shear parallel to minor axis, V2

Ratio	:	0.00		
Capacity	:	0.20 [Kip/in2]	Reference	: (Sec. 3.4)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	:	0.00		
Capacity	:	0.16 [Kip/in2]	Reference	: (Sec. 3.4.2)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✓

Ratio	:	0.00		
Capacity	:	0.11 [Kip/in2]	Reference	: (AITC-TCM)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio : 0.17

Ctrl Eq. : D2 at 0.00%
Reference : (Eq. 3.9-1)

CRITICAL STRENGTH RATIO ✔

Ratio : 0.17
Ctrl Eq. : D2 at 0.00% Reference : (Eq. 3.9-1)

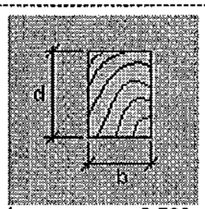
Member : 19
Design status : OK

PROPERTIES

Section information

Section name: S4S 4x4 **(US)**

Dimensions



b	=	3.500	[in]	Width
d	=	3.500	[in]	Height

Properties

Section properties	Unit	Major axis	Minor axis
Gross area of the section. (Ag)	[in2]	12.250	
Moment of Inertia (principal axes) (I')	[in4]	12.505	12.505
Top elastic section modulus of the section (local axis) (Ssup)	[in3]	7.146	7.146

Material : SPine_No2

Properties	Value
Type:	Lumber
Species:	Southern Pine
Grade:	No.2
Coefficient of variation:	0.25

DESIGN CRITERIA

Description	Unit	Value
Temperature:	--	T<=100F
Moisture conditions:	--	Dry
Wood:	--	Unincised
Repetitive member:	--	No
Type:	--	Column
End notches at top:	--	Top
Notch length:	[in]	0.00
Notch depth:	[in]	0.00

Description	Unit	Major axis	Minor axis
Physical length	[ft]	4.38	
Effective length for bending (Le)	[ft]	0.00	
Unbraced length for bending (Lu)	[ft]	4.38	
Unbraced compression length (Lx, Ly)	[ft]	4.38	4.38
Effective length factor (K)	--	1.00	1.00
Lateral bracing	--	No	No
Bearing length (Lb)	[in]	0.50	
Length between inflection points (Li)	[ft]	4.38	

SERVICE CONDITIONS

Verification	Unit	Value	Ctrl EQ	Reference
Deflection in compression and/or bending	--	-0.03	S2 at 100.00%	

DESIGN CHECKS

DESIGN FOR TENSION ✔

Ratio	:	0.00			
Capacity	:	0.74 [Kip/in2]	Reference	:	(Sec. 3.8)
Demand	:	0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for tension (Ft)	[Kip/in2]	0.83	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CFt)	--	1.00	(Sec. 4.3.6)
Incising factor (CiFt)	--	1.00	(Sec. 4.3.8)
Tension axial force (P+)	[Kip]	0.00	

DESIGN FOR COMPRESSION ✔

Ratio	:	0.11			
Capacity	:	1.38 [Kip/in2]	Reference	:	(Sec. 3.6.3)
Demand	:	-0.15 [Kip/in2]	Ctrl Eq.	:	D2 at 0.00%

Intermediate results	Unit	Value	Reference
Axial design value for compression (Fc)	[Kip/in2]	1.65	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Column stability factor (CP)	--	0.73	(Eq. 3.7-1)
Compression axial force (P-)	[Kip]	-1.82	
Modulus of elasticity for stability (Emin)	[Kip/in2]	580.00	
Adjusted modulus of elasticity for stability (Emin')	[Kip/in2]	580.00	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)

Buckling stiffness factor (CT)	--	1.00	(Sec. 4.4.2)
Critical buckling design value (FcE1)	[Kip/in2]	2.12	(Sec. 3.9.2)
Critical buckling design value (FcE2)	[Kip/in2]	2.12	(Sec. 3.9.2)

DESIGN FOR FLEXURE

Bending about major axis, M33

Ratio	: 0.00		
Capacity	: 1.73 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fb)	[Kip/in2]	1.50	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Mxx)	[Kip*ft]	0.00	
Slenderness Ratio (RB)	--	5.25	(Eq. 3.3-5)
Critical buckling design value (FbE)	[Kip/in2]	25.21	(Sec. 3.3.3.8)

Bending about minor axis, M22

Ratio	: 0.00		
Capacity	: 1.35 [Kip/in2]	Reference	: (Sec. 3.3)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Bending design value (Fbyy)	[Kip/in2]	1.50	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Stability Factor (CL)	--	1.00	(Sec. 3.3.3)
Size factor (CF)	--	1.00	(Sec. 4.3.6)
Flat use factor (Cfu)	--	1.00	(Sec. 4.3.7)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Repetitive member factor (Cr)	--	1.00	(Sec. 4.3.9)
Bending moment (Myy)	[Kip*ft]	0.00	

DESIGN FOR SHEAR

Shear parallel to minor axis, V2

Ratio	: 0.00		
Capacity	: 0.20 [Kip/in2]	Reference	: (Sec. 3.4)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D2 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	1.15	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	
Notch factor (CN)	--	1.00	(Sec. 3.4.3)

Shear parallel to major axis, V3

Ratio	: 0.00		
Capacity	: 0.16 [Kip/in2]	Reference	: (Sec. 3.4.2)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	: D1 at 0.00%

Intermediate results	Unit	Value	Reference
Shear design value (Fv)	[Kip/in2]	0.18	
Duration factor (CD)	--	0.90	(Table 2.3.2)
Wet service factor (CM)	--	1.00	(Sec. 4.3.3/5.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Table 4.3.8)
Shear Force (Vy)	[Kip]	0.00	

DESIGN FOR TORSION ✔

Ratio	: 0.00			
Capacity	: 0.11 [Kip/in2]	Reference	:	(AITC-TCM)
Demand	: 0.00 [Kip/in2]	Ctrl Eq.	:	D1 at 0.00%

Intermediate results	Unit	Value	Reference
Torsion design value (Fvt)	[Kip/in2]	0.12	
Torsion moment (Mtor)	[Kip*ft]	0.00	

DESIGN FOR BEARING (Informative)

Intermediate results	Unit	Value	Reference
Maximum reaction (Rmax)	[Kip]	2.60	(Sec. 3.10.3)
Load angle (θ)	--	0.00	
Axial design value for compression (Fc*)	[Kip/in2]	1.49	
Comp. design value perpendicular to grain (Fcp)	[Kip/in2]	0.57	
Wet service factor (CM)	--	1.00	(Sec. 4.3.3)
Temperature factor (Ct)	--	1.00	(Sec. 2.3.3)
Incising factor (Ci)	--	1.00	(Sec. 4.3.8)
Bearing area factor (Cb)	--	1.75	(Eq. 3.10-2)

INTERACTION ✔

Combined axial and bending interaction value

Ratio	: 0.01		
		Ctrl Eq.	: D2 at 0.00%
		Reference	: (Eq. 3.9-3)

CRITICAL STRENGTH RATIO ✔

Ratio	: 0.11		
Ctrl Eq.	: D2 at 0.00%	Reference	: (Sec. 3.6.3)

Bentley Meadowood Barn –Truss Purlin

Current Date: 4/5/2011 10:59 AM
Units system: English
File name: N:\NCR 2011\2142.11 Poz Env BLM Barn Study\ram\truss\truss_purlin_const.etz\

Wood Design

Design code: AF&PA NDS-ASD-2005

Report: Summary - Group by member

Load conditions to be included in design :

D1=DL
D2=DL+LL
D3=DL+0.75LL

Description	Section	Member	Ctrl Eq.	Ratio	Status	Reference
	S4S 2x4	1	D2 at 50.00%	**1.44**	**N.G.**	(Sec. 3.3)

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- Structural Engineering
- Structural Detailing (BIM)
- Design/Planning
- Facilities Management
- Construction Services
- Integrated Project Delivery (IPD)

Project Name: Meadowood Barn
Subject:
Project Number:
Calculations: By:
Checked: By:
Sheet: of

CHECK Purlins @ Stall (2x4 Flat @ 24" O.C. SPAN = 4'-0")

LL = 15.2 (2'-0") = 30.4 lb/ft
DL = 5 (2'-0") = 10 lb/ft

fb actual = 754 psi
FB allowable = 775 psi

$\boxed{.973 < 1 \therefore OK}$

CHECK ROOF members @ STALL SPAN = 4'-0"

LL = 15.2 (4'-0") = 60.8 plf
5 (4'-0") = 20 plf

fb = 255
FB = 775

$\boxed{.34 < 1 \therefore OK}$

CHECK ROOF @ AISLE SPAN = 11'-10"

fb = 430 psi
FB = 775

$\boxed{.55 < 1.0 \therefore OK}$

CHECK 2X BEAM @ AISLE / STALL

fb = 667
FB = 775

$\boxed{= 0.86 < 1}$

$\therefore$ OK

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CHECK ARENA Porch

$f_b = 1292$

$F_B = 775$

$1.66 > 1.0 \therefore NG$

FOUNDATION DESIGN

$D_L = 80\,plf\,(30) + 80(6) = 2880\,\#$

$L_L = 121.6\,(30) + 121.6(6) = 4378\,\#$

Total Load $7250\,\#$

ASSUME 2000 psi bearing $\Rightarrow \frac{7250}{2000} = 3.6\ sf$

$A = \pi r^2 \Rightarrow 3.6 = \pi r^2$

$r^2 = 1.15$

$r = 12''$

USE 2'-0" DIAMETER FTG.